THURSDAY, MAY 22, 1890.

THE FUTURE UNIVERSITY FOR LONDON.

THE latest news of the negotiations between the various institutions whose co-operation is necessary for the establishment of a satisfactory system of graduation for London University students is decidedly good. Lord Cranbrook, as the Minister in charge of educational legislation, has intimated to the University that he is prepared to take up the question, and is in expectation of receiving an application for a new charter for the purpose of instituting such a system. The scheme which was drafted by a Committee of the Senate, which was communicated to the University Colleges and to the Royal Colleges of Physicians and Surgeons, and was under discussion at the meeting of the Convocation on the 14th inst., contains some novel features, which show that the University is prepared to move forward, in order to meet the immediate necessities of the situation, beyond the recommendations of the abortive Royal Commission of 1888, and far beyond the *non possumus* of the University witnesses before that Commission. It practically embodies the concession of a separate system of graduation, to be conducted by an administrative Committee of the Senate, upon which the teaching institutions shall be adequately represented, independently of the present system of graduation by open examinations. It contains a further excellent suggestion, that this present system shall also be conducted by a Committee of the Senate, the Senate itself remaining the ultimate authority for both systems, but leaving the details of administration to the two Committees. This plan, which is due to the initiative of the Senate Committee, appears likely to meet objections of Convocation and of the country University Colleges, and must render it easier for the London institutions to accept the Senate as the ultimate authority on the teaching side.

Accordingly we are not surprised to hear that the University Colleges have expressed themselves ready to accept the proposal, and to abandon, subject to a satisfactory settlement of details, their petition for a separate University. We trust that a spirit of mutual concession will continue to sway the counsels of the contending parties, and that we may be able to hail the establishment of the teaching side of the University of London, which will be the real University for London, during the present year. The new system of graduation will follow the teaching in the London colleges and schools, which will be organized for the purpose by the London Committee of the Senate. We trust that it will be complete in itself, and that its administrators will receive powers to develop it without unnecessary restrictions. The development, in particular, by means of what is known as University Extension lectures has been recognized by the Senate Committee as work which properly belongs to the teaching side for London, and should be placed under the London Committee. This removes a difficulty, which might have been serious, in the way of agreement with the University Colleges. Another, which arose from the embodiment by the Senate Committee in their scheme of the Scottish system of examinations—a system considered in England to leave too much to the discretion of the individual professor, and unsuited to the circumstances of London, where there will be, in most subjects, at least two professors—has also, as we are informed, been removed by concessions from the Senate Committee.

Of the points which remain for settlement the most important are the composition of the Committee for London, and the place in the University of the London Medical Faculty. The first is matter for mutual discussion and arrangement between the various institutions and interests concerned. The University Colleges claim that, besides the "Faculty" representatives, or professors, there shall be three representatives upon the Committee of the Council of each of the Colleges. Since the University is not willing that there should be any members on the Committee who are not also members of the Senate, this involves the further point that the six Council members shall be admitted to the Senate. By our latest advices the Senate Committee appear not unwilling to make this further concession, which is deemed indispensable by the Colleges. It can hardly be said to be an extravagant demand, if the importance of the two great Colleges in the teaching system is considered.

With regard to the Medical Faculty, the representatives of the Royal Colleges of Physicians and Surgeons, and those of the hospital schools unconnected with a University College, besides the two University Colleges, will be consulted. The plan recently put forward by a Committee of the Royal Colleges, which had not been in communication with the University Colleges, involved the constitution of a Joint Committee of the University and the Royal Colleges only, for the purpose of administering a system of "pass" degrees in medicine, in which the examinations of the Conjoint Board of the Royal Colleges should be recognized as an equivalent for the present intermediate examinations and B.M. examinations of the University, and a new M.D. degree should afterwards be given, upon a University examination. We are glad to find that the proposal of the Royal Commissioners to hand over the preliminary scientific examination to the Royal Colleges, which has been condemned in these columns, is entirely disapproved by the Royal Colleges themselves. The severance of the scientific education of medical students from that of scientific students generally is to be deprecated in the interests of scientific study. The same argument seems to us to make for the inclusion of the system of medical graduation for London students in the work of the general London Committee; and we should by no means view with favour the proposal for assigning it to a separate Committee, whether constituted jointly by the University and the Royal Colleges, or as a third Committee of the Senate. In either case representatives of the Royal Colleges and of the medical schools may properly find places on the Senate. Why should they not also form part of the General Committee for London, which would thus become the single administering body for all the Faculties, so far as the teaching side was concerned? The proposal of the Royal Colleges to limit the medical degrees, upon the teaching side, to "pass" degrees, and to bar the University in this respect from conferring honours, appears inadmissible. It probably would not have been made by the Royal Colleges had they been aware of the willingness of the Senate Committee to concede the

point to the University Colleges, so far, at all events, as regards honours in arts and science.

We are informed by a legal correspondent that a strong Committee has been formed at Lincoln's Inn to promote reforms in legal education. We trust this may prove the first step to the constitution, on the teaching side of the University, with the co-operation of the Inns of Court, of a real Legal Faculty, on a basis similar to that above recommended for medicine. To separate the professional Faculties from the academical, in a University of the nineteenth century, savours of anachronism.

RECENT ORNITHOLOGICAL WORKS.

Classification of Birds; an Attempt to diagnose the Sub-classes, Orders, Sub-orders, and some of the Families of Existing Birds. By Henry Seebohm. Pp. i–xi., 1–53. (London: R. H. Porter, 1890.)

A Hand-book of European Birds, for the use of Field Naturalists and Collectors. By James Backhouse, Junr. Pp. i–viii., 1–334. (London: Gurney and Jackson, 1890.)

THE most important ornithological work which has recently appeared is undoubtedly Mr. Henry Seebohm's "Classification of Birds." Any attempt to arrange the class "Aves" is always warmly welcomed by ornithologists; and whether they agree or not with all Mr. Seebohm's conclusions, they have every reason to be grateful to him for an honest effort to diagnose the existing orders of birds. It has been known to most of us that Mr. Seebohm has been engaged, with his usual energy, in a close study of avian osteology for the last two years, and the present "Classification" is the result of his original studies, combined with a careful digest of the work of his predecessors in the same field—Parker, Fürbringer, Garrod, Forbes, and others.

The author starts with a high purpose, and with a resolve that diagnoses shall be found which shall hold good for each group of birds, and that the combination of characters set forth shall be diagnostic of that group, and of that group alone. No one, therefore, can grumble at the arrangement, because the order can be altered at will, each order and sub-order possessing their absolutely special characters. Two schemes for the higher classification of birds are proposed. In the first one the author recognizes six sub-classes, as follows:—I. Passeriformes; II. Falconiformes; III. Coraciiformes; IV. Anseriformes; V. Galliformes; and VI. Struthioniformes.

In his "Alternative Scheme" he reduces the number of sub-classes into *five*, by merging the Falconiformes, the Anseriformes, and the Galliformes into the sub-classes Ciconiiformes and Galliformes, the latter taking in the Lamellirostres of the first classification, and sending in return the Tubinares and Impennes back to the Ciconiiformes.

The condition of the young at birth forms the groundwork of this second method of classification, which the author approves, but the subject is treated in a method different from that of Sundevall, who also thought highly of the condition of the nestling bird as an element of primary classification, but, according to Mr. Seebohm, he attached an exaggerated importance to some of the facts. That the character of the nestling is bound to play a significant part in the classification of birds we can well understand, but at present the various developments of the downy young are, we believe, but imperfectly understood. Thus we may remark that in the Passeriformes we know at least two exceptions to their diagnosis as given by Mr. Seebohm, viz. in the Shore Lark (*Otocorys alpestris*), and in a curious bird from Ecuador, *Ptilochloris buckleyi*, belonging to the family *Pipridæ*. Other examples will doubtless be found, and yet closer examination will probably demonstrate that the downy stage through which these Passerine birds pass will be of a different fundamental character from the downy stages of other birds.

There can be but little doubt that of the two schemes provided by Mr. Seebohm the second one is the best, but a stumbling-block at first sight appears to be the position of the *Columbæ* in the Passeriformes, and that of the *Cathartes* (*lege* Cathartides) in the Coraciiformes with the Kingfishers and Hornbills. It is perhaps the novelty of these allocations that causes our hesitation in accepting them, for after all a Turkey Vulture and a Ground Hornbill (*Bucorax*) have considerable resemblance. In any case Mr. Seebohm gives characters for the diagnosis of all his Orders and Sub-orders, and their linear arrangement can be shifted at will. Each order and sub-order is not only defined, but a table accompanies every one of them, showing the whole of the thirty-six minor divisions, exhibiting by an asterisk the want of any specified character, and so narrowing the issue of definition in each instance. The author is greatly to be congratulated on the result of his two years' labour, which will doubtless be the stepping-stone to further treatises on the classification of birds.

We cannot congratulate Mr. James Backhouse on his "Hand-book of European Birds." The author's intention doubtless is good, but though "many of the finest bird collections in the Kingdom have been carefully examined, and the best modern authorities have been consulted," the result of all this compilation is not satisfactory, and a want of practical acquaintance with the manner in which a "Hand-book" should be written is apparent at every step. We fear that the outline figure of a bird, drawn by Mr. R. E. Holding, in order to show the nomenclature of the different parts of a bird, will not commend itself to any experienced field naturalist or collector, who will probably know more of his subject than did the artist who perpetrated this figure. We will do no more than point out that the "cervix" is called the "hind neck" by most ornithological writers, that the "malar region" is generally spoken of as "the cheeks," that the positions of the "breast," "abdomen," and "anal region" are all placed wrongly in the figure, and that the "crissum" is not the same as the "lower tail-coverts." The divisions of the back are also wrongly defined. Luckily, the author himself does not recognize the terminology of his own "bird-map," or the confusion of parts would have been disastrous.

We had fondly hoped that, having started the "Birds of Europe" in 1871 (since completed by Mr. Dresser), with the idea that a work of that character should include all the species of the Western Palæarctic region, which is at least a natural division of the globe, it would not

occur to future authors to return to the old idea of treating the avifauna of Europe on political ideas, and fencing in the ranges of the birds with political boundaries. Yet it is on these old lines that Mr. Backhouse has written his "Hand-book," and he must be held responsible for a very retrograde step. From his preface, with the short definition of the six zoogeographical divisions of the earth, one would expect to find that he recognized the value of writing on the birds of a well-defined zoological area, but a glance at the countries which he assigns to the Ethiopian and African regions shows that he does not really understand the subject of geographical regions, for, after stating that the Western Palæarctic sub-region includes the countries *west* of the Jordan, he apparently wishes us to believe that Palestine *east* of the Jordan belongs to the Eastern Palæarctic sub-region, while Asia Minor is to remain in the western part. We should like to know where the regional differences between Asia Minor and Persia, and, for that matter, Palestine and Syria, begin and end. Arabia seems to be left out in the cold, finding a place neither in the Palæarctic nor in the Ethiopian regions, while the Indian region includes Asia south of the Himalayas with the Indo-Malayan Islands and Formosa, as well as *Madagascar!* With such crude notions as to the limits of the regions which adjoin the Palæarctic, it is not to be wondered at that Mr. Backhouse's ideas of the natural limits of the latter are also ill defined. The mischievous results of these notions of the limits of "Europe" are seen in the appendices of North American birds which are "*stated*" to have occurred in Europe. Many of the birds mentioned in his list have undoubtedly occurred more than once, and the incompleteness of the plan of the work is shown by their omission from the body of it, because these species may occur again at any time to the "field naturalist" or "collector," for whom the author specially caters, and these will look in vain for them in this "Hand-book." The same with the list of Asiatic and African species which are *stated* to have occurred in Europe. Many of them *have* occurred in Europe, beyond the shadow of a doubt, and *Certhilauda duponti* (of *C. lusitanica* the author apparently knows nothing), *Sturnus purpurascens*, and *Falco minor*, have as much right to be considered European birds (even in Mr. Backhouse's acceptation of the term), as *Picus lilfordi* or *Cypselus pallidus* (whose range is *not* "probably similar to that of *C. apus*," or anything like it).

The main idea running through Mr. Backhouse's "Hand-book" seems to be the same as was exemplified in Colonel Irby's "Key List to British Birds," but we greatly prefer the plan of the latter pamphlet for its method of execution to the more ambitious work of Mr. Backhouse, wherein most of the mistakes of Dresser's "Birds of Europe" are reproduced, even to the omission of the Astrachan Horned Lark (*Otocorys brandti*)! Besides the faults we have noted, all of which are easily capable of rectification in a future edition, there is one cardinal defect in this "Hand-book," and that is in the assumption that the "field-naturalist" and "collector," for whom the author writes, is minutely acquainted with Palæarctic *genera*, and will know instinctively whether he has a *Hypolais*, an *Acrocephalus*, or a *Lus-ciniola* in his hands.

R. BOWDLER SHARPE.

CRIMINAL ANTHROPOLOGY.

The Criminal. By Havelock Ellis. Illustrated. (London: W. Scott, 1890.)

CRIMINAL anthropology has of late years attracted much attention abroad, where its problems have been largely and often very loosely discussed. Mr. Havelock Ellis performs the useful task of making English readers acquainted with the results. It cannot be said that much progress has been made on the psychological side of the subject since the publication of Despine's "Psychologie" in 1868, but the main conclusions of that author have been abundantly confirmed. On the physical side, numerous dissections and measurements seem to have led to no well established and important fact; they have, however, narrowed the limits within which speculation may legitimately ramble. It is well ascertained that many persons are born with such natures that they are almost certain to become criminals. The instincts of most children are those of primæval man; in many respects thoroughly savage, and such as would deliver an adult very quickly into the hands of the law. The natural criminal retains those same characteristics in his adult life. The author has a very true but not complimentary passage upon the ways of children. He says that the child lives in the present, the desire of the moment blotting out everything else from his mind. That he has no foresight to restrain him from acting according to impulse. That he is a thorough egoist, and will commit any enormity to obtain what he wants. That he is cruel and enjoys the manifestations of pain. That he is a thief for the gratification of his appetites, chiefly of gluttony; and that he is an unscrupulous and often cunning liar, not hesitating to put the blame on innocent persons when his own misdeeds are discovered. In the large majority of our countrymen the savagedom of childhood becomes gradually in part repressed, in part outgrown, and in part transformed. Discipline is one agent, another is the larger growth of sympathetic feelings, and another is the education of a habit of forethought, which prompts selfishness to be wise, and induces many persons to assume throughout life the appearance of virtues for which they have no care, solely through the fear of social or legal punishment. We may freely allow that everybody is liable under some circumstances to fall into crime, for, in the words of the liturgy, "we are set in the midst of so many and great dangers that by reason of the frailty of our nature we cannot always stand upright," but the difference between ordinary persons and natural criminals is that the latter are unable to stand upright even under favourable conditions. There are numerous human beings who have an instinctive aptitude to various forms of ill-doing, no sense of remorse for the sufferings they may have caused, and who possess too little forethought and self-restraint for the fear of retribution to become effective. Abundant evidence of all this is to be found in Mr. Ellis's book, and there seems to be a consensus among experts as to its trustworthiness.

It is easy to understand that ordinary men who are thrown among criminal associates will soon acquire their furtive expression and other peculiarities of demeanour; but after making all allowance for these acquired characteristics there remain certain natural ones that

predominate among all large groups of criminals. These are well set forth by Mr. Ellis, chiefly under the titles of cranial characteristics, physical insensibility, moral insensibility, and emotional instability. A fresh indication of frequent misshape in their heads may be derived from the three composite portraits of criminals (who were by no means of a bad order) that are given in this volume. Here the outlines of the heads of the composites are very hazy, testifying to large and *various* differences in the component portraits. These composites show no prevalence of any *special* deformity in head or features.

The hope of the criminal anthropologist is to increase the power of discriminating between the natural and accidental criminal. He aims at being able to say with well-founded confidence of certain men that it is impossible to make them safe members of a free society by any reasonable amount of discipline, instruction, and watchfulness, and that they must be locked up wholly out of the way. Also, to say of some others that it would be both cruel and unwise to treat them as ordinary criminals, because they have been victims of exceptional circumstances: they are not naturally unfit, and therefore still admit of being turned into useful members of society. Extracts are given in this book from the official reports of the prison at Elmira in the United States, where experiments are made in educating prisoners of the latter class. They describe a system of massages and Turkish baths three times a week, courses of literature, æsthetics, and ethics, including a study of Jowett's translation of the "Republic" of Plato, and of the works of Herbert Spencer, together with a gymnasium and a drum corps, suggesting to the unprepared reader a chapter in Gulliver's account of the institutions of Laputa.

FRANCIS GALTON.

ELEMENTARY PHYSIOGRAPHIC ASTRONOMY.

Lessons on Elementary Physiographic Astronomy. By John Mills. (London: Chapman and Hall, 1889.)

THE expressions of approval of the physiography syllabus of the Science and Art Department by the British Association Committee on science teaching lend an additional interest to new text-books of this subject. The book before us covers the portion of the syllabus dealing with the movements of the earth. We believe Mr. Mills has occasionally been employed as an Assistant Demonstrator at the Normal School of Science, and on the strength of this he claims to have had four years' experience as a teacher of the subject in that institution. It is rather late for Mr. Mills to state that, "in the hope of encouraging teachers and students to make the subject a more practical one, instructions have been given for making some inexpensive apparatus," considering that all the practical work given is taken from the book of instructions supplied to students at the Normal School, and which was distributed by the authorities of the Science and Art Department to teachers throughout the country some months ago, with the sole object of encouraging practical demonstrations in classes. Anyone can now obtain the same for twopence. There are many indications that the author is only acquainted with a limited part of the subject. The article on the use of the micrometer, for example (p. 25), is sure to impart the idea that a definite fraction of an inch represents a definite amount of arc, irrespective of the telescope employed; and that, in consequence, the distance between two stars or the apparent diameter of a planet can be stated in inches; further, the zero for position angles is given as "the normally horizontal wire," which is obviously an inconstant, and therefore useless one. Wrong impressions are also given as to the functions of the "Nautical Almanac," for p. 81 distinctly implies that it is a record of actual observations, whereas it is published three or four years in advance. Again, on p. 20, it is stated that the transit circle is made to read 90° when the telescope is pointing to the Pole, and therefore that "when the telescope is directed to any star crossing the meridian we obtain the north polar distance of the star, and this being known, we can easily determine its declination," which is neither clear nor correct.

After deducting the practical instructions, the most casual comparison with Prof. Norman Lockyer's "Movements of the Earth," will show the source of inspiration of the remainder, although there is not a word of acknowledgment. The head-lines, diagrams, and occasionally the language, remind one of that book. The order of things has certainly been slightly changed, but the only result is to introduce disconnections and anticipations. The micrometer, for example, is described before the chapter on angular measurements, and the chronograph precedes that on the measurement of time. The terms "right ascension" and "declination" are frequently used, although the explanation of them is reserved for the very last page. Further instances might be multiplied almost without limit.

The whole book is of a very sketchy character, and the only redeeming feature is the excellent series of diagrams.

A. F.

OUR BOOK SHELF.

Theoretical and Practical Treatise on the Strength of Beams and Columns. By Robert H. Cousins, Civil Engineer, formerly Assistant Professor of Mathematics at the Virginia Military Institute, Lexington, Va. (London and New York: E. and F. N. Spon, 1889.)

THE author of this treatise comes forward with an attempt at an explanation of the *paradox of the beam*, which is that a beam is about double as strong as theory makes out it should be, when the resistance of the beam to bending is calculated from the tension and pressure of the fibres, considered as acting independently and without lateral support.

To account for this discrepancy, which is well known to practical men, a paper by W. H. Barlow, in the Phil. Trans., 1855, proposed a theory of lateral support of the fibres to account for the extra strength, while his careful experiments showed that the neutral plane was certainly very close to the position which theory assigned to it. Previously it had been usual for practical men to place the neutral plane at the top or bottom of the beam, and thence to calculate the strength; a better agreement with theory being thus obtained.

The author of the present treatise adopts the more modern method of taking a different tenacity and modulus of elasticity of the material for extension and for compression; his calculations are principally directed to finding the breaking load of the beam; but as all the

laws of elasticity break down long before breaking takes place, it is not surprising that he should find himself in disagreement with the results of theoretical elasticity.

A summary of the author's theory is given on p. 31, in the shape of ten hypotheses, most of which are of general acceptation, except perhaps number 8, which asserts that "The algebraic sum of the direct forces of compression and extension can never become zero;" while number 4 is redundant, and opposed to the principles of elementary statics.

After the length of time the theory of the beam has been worked at, it is natural to expect the treatment to have fallen into a conventional groove; but there is an unfamiliar appearance about the present pages, which makes it difficult to find out where the originality claimed by the author for his theory comes in; while many of his statements about the position of the neutral line (p. 27) "at the inception of the loading being at the bottom or extended side of the beam, and moved upwards by reason of the deflection and equally with it," are in direct opposition to the careful observations of Mr. W. H. Barlow.

A great many additional pages, reaching to number 166, are devoted to applications to beams of different materials, cast-iron, wrought-iron and steel, and timber; but the method is the same throughout, so that the essence of the book would go into very few pages. The treatise is a great contrast in this respect to most recent American publications on practical subjects.

A. G. G.

Chambers's Encyclopædia. New Edition. Vol. V. (London and Edinburgh: W. and R. Chambers, 1890.)

THE new volume of the present edition of "Chambers's Encyclopædia" deserves in all respects as cordial a reception as that which has been given to the preceding volumes. The editor has done his work with admirable care, selecting for the various subjects writers competent to deal with them, and setting apart for each subject, as nearly as possible, the space that properly belongs to it in accordance with the scheme of the work as a whole. Of the strictly scientific contributions, we need only say that those of them we have been able to examine are sound and concise. With regard to the articles on geology and heat, it may be enough to mention that the latter is by Prof. Tait, the former by Prof. James Geikie, to whom also have been intrusted the articles on the Glacial period and the geology of Great Britain. The climate of Great Britain is the subject of a short but luminous paper by Dr. Buchan. An excellent account of gas and gas-lighting is given by Dr. Alfred Daniell, and Prof. Ewing describes the gas-engine. Mr. Keltie contributes an interesting paper on geography, and Dr. J. S. Mackay writes with his usual clearness on geometry. Mr. F. Hindes Groome's article on the gypsies may be noted as a capital summary of many curious facts and theories. Mr. J. Arthur Thomson, in his article on heredity, displays wide reading and an impartial judgment; and Dr. J. Anderson's article on hill-forts shows how much solid information may be packed into a small space by a writer who knows his subject thoroughly.

Essays of an Americanist. By Daniel G. Brinton, M.D. (Philadelphia: Porter and Coates, 1890.)

MOST of the papers in this volume have already been printed, but some have been substantially re-written, and each of them derives an added value from the fact that it appears in association with other essays on kindred subjects. Dr. Brinton classifies the various papers under the four headings, "ethnologic and archæologic," "mythology and folk-lore," "graphic systems and literature," and "linguistic." To those who are familiar with his contributions to ethnology and anthropology we need scarcely say that the volume sets forth the results of much fresh thought and solid work. In some respects the conclusions at which Dr. Brinton has arrived differ widely from those of most other anthropologists. He holds, for example, what he calls "the specific distinction of an American race," and "the generic similarity of its languages." He is also persuaded that the tribes of this race "possessed considerable poetic feeling," and maintains "the absolute autochthony of their culture." These and other positions he defends with much ingenuity, and even those readers whom he may fail to convince will find that it is worth while to master his arguments. As an example of the thorough way in which he works at his subject, we may note his chapter on the Toltecs, whose far-famed empire he describes as "a baseless fable."

Esquisse Historique sur la Marche du Développement de la Géométrie du Triangle. By E. Vigarié. (Association Française pour l'Avancement des Sciences—Congrès de Paris, 1889.)

THIS is a full and carefully drawn-up sketch of what is sometimes called the modern geometry of the triangle. It carries on the bibliographical notice contributed by M. E. Lemoine to the same Association (1885) up to the present time, and supplies some of the lacunæ in that notice. The author appears to be very fair towards foreign mathematicians, and any deficiencies in noticing English contributions are due to there being at present no account of results which may be buried in such journals as the *Mathematician*, the *Lady's and Gentleman's Diary*, and similar works. We have little doubt that an examination of these would lead to the unearthing of many anticipations of recently obtained results.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Uniform System of Russian Transliteration.

IN NATURE, vol. xli. pp. 396–97, which has only now reached Tashkend, there is a very interesting note under the above title. It is stated that "the recommended system will be adopted without delay." How is this to be understood? Does it mean that the system is finally settled? It would be a pity if this were so, because the proposed method of transliteration contains a point which would be a source of perplexing difficulties when used in practice.

The suppression of the semi-vowels ъ and ь (hard and soft pronunciation) at the ends of words, would make many of them indistinguishable. For instance, with the propo ed system, the words

	пыль (dust)	would be	= *puil*
and	пылъ (heat)	,,	= *puil*
	былъ (did heat)	,,	= *bil*
and	бильь (a bill)	,,	= *bil*
	яръ (precipice)	,,	= *yar*
and	яръ (verdigris)	,,	= *yar*
	данъ (given)	,,	= *dan*
and	дань (tribute)	,,	= *dan*

and so on.

The differences of these sounds exist for some purpose in the Russian language, and they ought to be rendered in some way in the transliteration. Perhaps the simplest plan would be to adopt the Polish method of denoting the soft pronunciation with an *accent* above the letter in question. The words just given would then be written *dan* and *dań*, *yar* and *yár*, &c.

I may be allowed to make some further suggestions. They are of minor importance, but would tend to improve, in my opinion, the proposed system.

Would it not be more convenient to transliterate the Russian ы with *y*, as is done in the Polish language? The proposed symbol *ui* does not even remotely represent the right sound, and

may cause numerous cases of confusion with the very similar transliterations of the Russian sounds *yu* and *yĭ*. Moreover, English readers are already accustomed to render ы with *y*, as, for instance, in the name of the Pribylow Islands. Why should this name be changed now to *Pribuilow*, which is at the same time unfamiliar and misleading? If the change is made, *ю*, *ю*, *и*, must be written as *ie*, *iu*, *ia*.

The Russian ж might perhaps be better represented by *jh*. The symbol would then represent a softened *j*, equivalent to the French *j*, and reproduce the right sound. A. WILKINS.

Tashkend, April 2/14, 1890.

I ASSUME that the following three conditions must be fulfilled:—

(1) The object aimed at is *principally transliteration*, combined with the possibility of recovering, by its means, the original Russian spelling.

(2) Correct *pronunciation* is only a secondary object, as oral teaching alone can convey it in perfection. Nevertheless, the transliteration adopted should come as near the correct pronunciation as possible, without sacrificing the principal object, transliteration.

(3) The system adopted should satisfy a want, not only of the English-speaking nations, but also, as far as possible, of all those which use the Latin alphabet. This object can be reached only by some mutual concessions.

Now, the system adopted in the article in NATURE (vol. xli. p. 397) would, it seems to me, fulfil these requirements as nearly as possible, if the following comparatively slight modifications were admitted:—

(1) The Russian ж would be better rendered by *j* than by *zh*. ж has not quite the same sound as the English *j*, which in most cases has a sound of *d* in it (as in journey, jay, jam). But ж corresponds exactly to the French *j*, and is not too far remote from the German *jot*. For this reason, as a compromise between the three languages, *j*, as an equivalent of ж, would answer better than *zh*. I mean to say that, by means of the *j*, it will be easier for Englishmen, Germans, and Frenchmen to get at the right pronunciation of the Russian ж than through the medium of *zh*.

(2) The Russian ч (*tcha*) should be rendered by *tch* instead of *ch*, and that for the sake of the French and Germans, whose *ch* is pronounced differently from the English *ch*. For the English reader the adoption of either *tch* or *ch* would not involve any difference of pronunciation.

Thus, the Russian чай (tea) should be transliterated into *tchaĭ*, which the three nations would pronounce nearly in the same way; whereas, according to the proposed plan, it would be spelt *chaĭ*, which a Frenchman would pronounce *shaĭ* and a German something like *Khaĭ*. Чихачевъ should be spelt *Tchikhatchev*, and not *Chikhachev*.

(3) For a similar reason I would propose *stch* for the Russian щ instead of the *shch* of the proposed system. In Russian сть is pronounced exactly like щ (счастіе, *happiness*, is pronounced щастіе, and счетъ, *an account*, щетъ); and for this reason if ч (*tcha*) is rendered by *tch*, the addition of an *s* would make it щ (*stcha*). The *stch* would be more palatable for the French and Germans than the very puzzling *shch*.

(4) I should propose to use the sign ‿ for indicating the compound letters—thus, *t͡ch*, *s͡tch*, &c. This would much facilitate the eventual recovery of the Russian letters.

(5) The last letter of the Russian alphabet, Ѵ (called *ijitza*), is rendered by *oe* in the table (*loc. cit.*). This must be a misprint.

This letter has become almost obsolete in Russian, and is used in the Church Slavonic only. It is the exact equivalent of the Greek *ypsilon*, and should be rendered by *y*.

The requirements of the Italian pronunciation (with its *c* and *ch*[1]) and of the Spanish (with its *j*) are more difficult to satisfy; but most of the educated Italians and Spaniards understand other languages. CH. R. OSTEN-SACKEN.

Heidelberg, Germany, May 5.

The Eruption of Vulcano Island.

IN the pages of NATURE two notes have appeared from my pen describing the phenomena of the eruption that commenced on August 3, 1888, which *apparently* is now coming to an end. I have not been able to visit the spot recently, but my friend and pupil Mr. Lewis Sambon, who helped me in conducting the party of English geologists through the Lipari Islands last autumn, and on whom I can thoroughly depend, has given me the information that I make use of in these notes. Mr. J. P. Iddings, whom Mr. L. Sambon accompanied, also kindly confirmed some of the latter, besides which Mr. Sambon brought back a few very good whole-plate negatives.

From September 1889, when I and the geologists were at Vulcano, the eruption has continued with very varying activity. On March 15, 1890, at 9 p.m., there was a very violent explosion resembling the blowing up of a mine. Some windows were broken at Lipari, which is about seven kilometres distant, whilst lapilli reaching the size of large peas, with drops of condensed vapour, were showered upon the town. Behind Monte della Guardia, which hides Vulcano from the town of Lipari, for upwards of three minutes a bright red reflection was seen, which is of importance as indicating the presence of incandescent matter in the volcanic chimney; for there are floating about a number of extraordinary hypotheses, some verging on the magical, to explain this eruption.

After the evening of the 15th, Vulcano was very active, but the explosions were gradually diminishing in force, and completely stopped on the 17th.

On March 25 my two friends visited the island. They found at the base of the cone an enormous number of the *bread-crust bombs*, the mode of formation of which I have already described and explained. These were of recent ejection, and Mr. L. Sambon says they much resemble those of the earlier period of the eruption; and the specimens which have been kindly brought to me thoroughly confirm this view. Both those examined on the island, and the smaller ones I received still contain numerous fragments of dolerite, which, as I have shown, give origin to much of the pyroxenes, magnetite, olivine, and triclinic felspar distributed throughout the paste, and the origin of which is proved by the fact that they are rarely without a bit of the old microlitic dolerite base still attached to them even when very small crystals nearly isolated occur. Such is the amount of impurity of the paste that any attempt at a chemical analysis would be a waste of time, and even the microscope can afford us little information as to the group of rocks to which the magma belongs. The general facies of the projectiles, the earlier products of this cone, all point to the rock being near to if not really a rhyolitic obsidian. Referring to a discovery I made last autumn Mr. Sambon says:—"I broke a great number of the bombs, but I found in none of them that white agglomeration of quartz and felspar that we often met with in September 1889." These inclusions much resemble numerous similar ones that I found in 1887 in an old lava stream of Stromboli, and which have been sliced, and the examination of which will be published soon. In the meantime they may be said to be composed chiefly of milky quartz and felspar of metamorphic or plutonic origin, and are no doubt the remnants of the sub-volcanic platform.

Some of the recent bombs reach gigantic sizes for such a small volcano. One of these, possibly shot out on March 15, 1890, was, above ground, 9 feet high, 6 feet broad, and 6 feet thick. The obsidian crust was 4 inches thick, and the main fissure, through which the pumiceous interior protruded, was 2 feet broad, forming, as it were, a monster crusty loaf.

So violent were the explosions on March 15, 1889, that Signor Jacono, Mr. Narlian's factor, had to fly for protection with his family to the caves near the Faraglioni, because great stones were falling in considerable numbers near Mr. Narlian's villa, which is about a kilometre from the crater.

Mr. L. Sambon describes the crater as some metres deeper than when we visited it together six months before; but, comparing his and my photographs, there has been very little change. The crater walls were covered with yellow sublimations, which were not so in September 1889, and he judges their inclination at from 40° to 45°. In the centre of the small floor was a great white patch with yellow border, which my experience would lead me to suppose to be due to boric acid, with the edges of a mixture of seleno-sulphur and realgar. A good deal of smoke (which is again new) was issuing from the bottom, especially to the north-north-east; and a few metres only from the edge of the slope beneath the highest point, and extending to where we took our photographs, were a considerable number of fumaroles. One of those nearer the last point (north-north-west) was much larger, issuing from a fissure, and so violent and

[1] In De Gubernatis's "Dizionario Biographico," 1879, *Tchikhatchev* is spelt *Cihaceff*.

menacing as to resemble the old *Caputo*. All of them were roaring, and emitting white fumes.

The fumaroles of the outer rim, including *Caputo*, were very active. These latter worked continuously, whilst the new one on the inner edge would stop and start afresh—a phenomenon I have occasionally seen at Vesuvius, in fumaroles which are in direct communication with the lava. The intermittence, then, seems to be due to the surging up of the lava so as to block from time to time the lower inlet, or to be in other cases dependent upon the bursting of the great vapour bubbles as they rise in the viscous paste.

If this is really the termination of the eruption, we have gained some considerable advance in the interpretation of the eruptive phenomena of a highly acid magma, which is of such feeble character as to be incapable on the one hand of producing a typical pumice, and on the other of giving rise to an outflow of lava. As before stated, differences of opinion will probably be raised as to the nature of the *essential* ejectamenta, and I have little doubt that it will be dubbed as being more basic than it really is in consequence of the presence of impurities of olivine, augite, &c. It may be wise, therefore, that the reasons that lead me to conclude its acid nature should be given. First and foremost, we have the intense viscosity indicated by the long intervals of the explosions and the *bread-crust structure* in the ejectamenta. Secondly, these *bread-crust bombs* I have only met with in the ejectamenta accompanying either rhyolitic or trachytic glassy eruption, such as the obsidians of Rocche Rosse, Forgia Vecchia in Lipari, and Monte Rotaro in Ischia. In the former locality we have a beautiful illustration of the formation of these bombs outside the crater. Towards the end of the Rocche Rosse explosive stage, during which the great crater was drilled and the white pumice erupted, a large mass of obsidian was hurled up, and fell on the crater edge at Monte Pelato. In consequence of the sudden shock on reaching the ground, the semi-plastic mass cracked, and each fragment, relieved from the surrounding pressure, expanded into a small *bread-crust bomb*.

In the third place, the glass of these Vulcano bombs is exceedingly light and transparent, and indicates anything rather than an abundance of any basic iron silicate.

On looking back through the records of fairly well described eruptions, I cannot resist the impression that the duration of an eruption, other proportions being maintained, is in direct ratio to the basicity of the magma which in fact brings about such a result in consequence of the higher viscosity as the proportion of SiO_2 increases. Of course more or less advanced crystallization will also have an influence, as well as the relative higher or lower temperature, in eruptions of pure glass, beside the greater or less abundance of dissolved water.

The appearance of so many new fumaroles which we did not see six months ago all indicates that Vulcano tends (provided there are no more active signs) to pass into a solfataric stage such as is its usual state.

In fine, I must thank Mr. L. Sambon, for so kindly observing carefully the phenomena at Vulcano and transmitting to me his notes, and also Mr. J. P. Iddings for information on the same subject.

H. J. JOHNSTON-LAVIS.

Naples, April 18.

Panmixia.

I AM glad to observe that his private correspondence has led Prof. Lankester to regard the doctrine of "panmixia," or "cessation of selection," in a much more favourable light than heretofore.

The form in which I stated this doctrine in 1874, and again in the present correspondence, is the form in which it has likewise been stated by Mr. Galton in 1875, by Prof. Weismann in several of his essays during the past decade, and by Mr. Poulton in his recent lectures. But, speaking for myself, I can see no objection to the form in which it is now presented by Prof. Lankester. For it seems to me immaterial whether we say that panmixia leads to a degeneration of size, shape, or structure, because the previously sustaining power of selection has been withdrawn; or whether we proceed to say that the reason why selection *has* a sustaining power is because, so long as it continues operative, its operation consists in eliminating variations below the standard of full efficiency. But although it appears to me that the latter point goes without saying, if its expression changes the whole aspect of the case in the view of Prof. Lankester, I can only regret that I did not express it in the first instance. I did not, however, understand that there was any question touching the fact of variations occurring below the standard of full efficiency, even as regards fully-developed organs of "well-established species." Therefore my argument was directed to show that, upon the "assumption" of such variability, under cessation of selection the standard will not rise *above* the previous "selection-mean," but always tend to fall *below* it, on account of reversion, &c.

Obviously, however, if we disallow that selection has any sustaining power, the doctrine of degeneration as due to its cessation becomes "absurd." Or, which is the same thing, if we "eliminate altogether" the "assumption" of congenital variations occurring below the standard of full efficiency (when once the parts in question have been completely developed by natural selection), and if we substitute a logically "*possible*" denial of such variations in respect of such parts by "assuming the ratio of birth-mean and selection-mean to be one of equality"—then, indeed, "the point of interest shifts." But surely the burden of proof lies on the side of anyone who denies this variability to fully-evolved organs. Even in the case of "well-established species" it *is* "improbable that there is identity between these two means"—or, in other words, that when once an organ has been fully *evolved* by natural selection, it no longer requires to be *maintained* by natural selection.

Again, "that some cases must occur in which the selection-mean-size is [actually] *smaller* than the birth-mean-size," appears to me true only of cases in which selection has been *reversed*—as, for instance, in flightless insects of oceanic islands. In such cases natural selection is actively engaged in pulling down its previous work. If natural selection be then withdrawn altogether, the adult-mean-size will probably increase. For not only will there now be no reversal of selection, but cessation of the *newer* selection will enable atavism in some measure to re-establish the state of matters which previously existed under the *older* selection. Such, at any rate, are the only cases in which I can imagine even the abstract "possibility" of the cessation of selection leading to an *increase* in size.

In short, the cessation of selection must always produce the opposite results to those which were produced by the selection which has ceased—unless, of course, there be any cases in which there is an "identity between the birth-mean and the selection-mean" (*i.e.* an absence of specific mutability). But even as regards such cases, if they are "assumed" to occur, the assumption amounts to a begging of the question by supposing that the selection has *already* ceased, and ceased when the parts had reached the point of their *maximum* development—an assumption which requires to deny any further mutability in respect of such parts, and therefore seems to me well-nigh incredible. Nevertheless, I fully allow that the more "well-established"—*i.e.* the *less variable*—a species, the smaller will be the necessity for the maintaining power of selection, and hence the smaller effect will result from its withdrawal. This, indeed, we see to be the case even in our domesticated animals—the "inflexible" goose, for instance, having suffered less change at the hands of panmixia than any of our other farm-yard animals.[1]

[1] Nearly all our other domesticated animals yield abundant proof of the potency of panmixia (witness the care with which "methodical selection" is practised on the progeny of pedigree strains), and if we distrust the analogy between artificial and natural selection in this case, we seem to be rather aiming a blow at the principle evidence of the whole Darwinian theory. But as panmixia must act *more rapidly*, and *more completely*, in the case of such newly-acquired products of heredity than it is likely to act in wild species, I agree that experiments ought to be tried upon the latter. Moreover, I fully accept the distinction which Prof. Lankester has drawn in his letter of the 1st inst. between "size" and "structure." But I may remark that the effect of this distinction is not to indicate that panmixia will have no power to reduce size, while it is capable of entirely abolishing structure. What it does indicate is, that because there are greater potentialities of variation in the case of "complex" structures than in the case of mere "bulk," the sustaining power of natural selection is of correspondingly more importance: hence the cessation of selection will lead to the disintegration of structure *more rapidly* and *more completely* than it will to the reduction of bulk—as I have already pointed out elsewhere in relation to the eyeless peduncles of dark-cave Crustacea. Touching other minor points, I may further remark that while in his earlier letters Prof. Lankester accepted Darwin's view that parts are highly variable when selection is withdrawn, in his letter of May 1 he says it is "incontrovertible" that the "only effect" of such wit drawal must be to increase the number of individuals near the average mean—*i.e.* that panmixia both *permits* and *prevents* variability. Again, with regard to what he says about there being no proof that the economy of growth is absent in highly-fed domesticated animals, see Darwin, "Variation," &c., vol. ii. pp. 345-46, where the best imaginable "proof" of this fact is given. And with regard to his criticism on my use of the terms "essence" and "cause," see Mill, "Logic," vol. i. pp. 53 and 378 *et seq.*, where the popular *abuse* of both these terms is shown to be exactly that which I have avoided.

Upon the whole, however, we have ended by reaching a much more satisfactory state of agreement than seemed possible when we began. For Prof. Lankester now says he deems it "certain that some cases must sometimes occur in which the selection-mean is larger than the birth-mean," and that as regards such cases I have his "full concurrence in stating that the cessation of selection leads to dwindling." And as he previously agreed that cessation of selection leads also to a loss of shape and disintegration of structure, the only question that remains between us is as to whether there are any cases in which completely developed organs cease to present variations of size below the standard of full efficiency, and therefore will remain unaffected by the withdrawal of the selection by which they were evolved. But this is a question which does not vitally affect the *principle* of panmixia; and it only remains to add that I do fully "reciprocate" what he has said as to there being "no ill-feeling between us."

GEORGE J. ROMANES.

Photo-electric Impulsion Cells.

BEFORE publishing in detail the results of many experiments on the generation of electricity by the action of light falling on certain sensitive substances, I wish to make known a result which seems to be of a most remarkable character.

In this communication I shall give merely enough information to enable a reader to understand the special result which I desire now to make known.

The photo-electric cell which I employ consists of a small glass tube, represented in the figure, filled with an alcohol; two metallic plates, P and Q, are immersed in the liquid; each

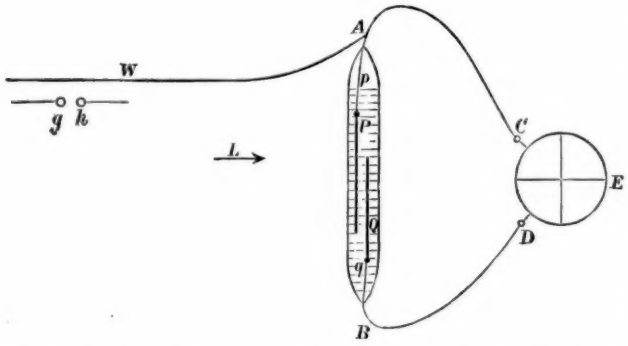


plate is connected with a platinum wire which may either be *soldered to the plate* or passed through a small hole in the plate and *pinched tightly to it*; these wires pass through the ends of the glass tube and are sealed into it. The poles of the cell are A, B, and these are connected with the poles of a quadrant electrometer (Clifton's form of Thomson's).

The plate P is sensitized by a peculiar process, the mere publication of the details of which would not enable a reader to make it successfully. The publication of the process is therefore reserved for a future occasion. The plate Q is quite clean—not sensitized to light. The cell is fixed vertically in a clamp (not represented in the figure). When the cell is of the "impulsion" kind, what happens is as follows. Daylight (represented by the arrow L) being allowed to fall on the sensitive plate P, the spot on the scale of the electrometer moves, and after a few seconds comes to rest, indicating an electromotive force varying with the intensity of the light, its amount for such diffused daylight as we have at present (May 10) at noon being between ½ a volt and ¾ of a volt—which is, I submit, a surprisingly great magnitude. On the withdrawal of the light, the deflection falls, and there are means of rapidly getting rid of the deflection without injury to the cell. Either before or after this deflection caused by light ceases, let a slight tap (sometimes inaudible) be given to the base or clamp in which the cell rests, and then results a remarkable change in the cell. *It is no longer sensitive to light.* This insensitive state is indicated by a rapid return motion of the spot on the scale; it is merely *indicated* by this motion, there being no necessary connection between this motion and the insensitive state, for if the cell were now left for some time (perhaps an hour or so) in the dark, the disturbing E.M.F. of the cell would vanish, and there would be nothing to tell us that the cell remains insensitive; but that it is really still in the insensitive state we find at once on again exposing it to light. Another gentle tap given to the clamp, or the stone table on which the whole apparatus rests, will restore the sensitive state; and so on indefinitely, the sensitive and insensitive states following each other and being produced, in the case of many such cells, with great ease.

These results I found a long time ago, and they have been seen by or communicated to several scientific friends. From the first, I maintained that the results are due to an alteration of the molecular state of the sensitive surface, or of the layer of contact of this surface with the liquid, and that in one arrangement of the molecules the light energy can be taken up electrically, while it cannot be so taken up in the other. In my first experiments the plates were tightly pinched to the platinum wires—not soldered, as soldering endangered the sensitive layer—and the obvious objection was made that "loose contacts" were unsatisfactory. I have several results, however, which dispose of this objection even in the case of very loose contacts; but I may set the matter at rest by saying that I have been able to make soldered junctions, and with them to obtain the results.

I now come to the special point which is the occasion of this communication. A few days ago I was investigating the effect of static charges communicated to the plates on the sensitive and insensitive states, and in the course of these experiments I found that if a Voss machine, not in any way connected with the cell or the electrometer, was worked in the room while the cell was in the insensitive state, *the moment a spark passed between the poles of the Voss, the insensitive state was altered to the sensitive*, whether the cell was connected with the electrometer or not. Finally, I found that the best method of showing the inductive effect of the spark is to connect an insulated wire, W, apparently of any length, to either pole (A in the figure) of the cell, and to place the poles, *g*, *h*, of the Voss near the wire (a distance of several feet will do with a spark about half an inch long). If *g* and *h* are two or three feet from any part of the wire W, a spark about one-eighth of an inch long suffices to change the cell from the insensitive to the sensitive state.

The effect is not one on the electrometer, nor is it due to sound, and I have repeated the results with several cells many scores of times before people interested in them. At present I am endeavouring to produce by *electro-magnetic induction* the reverse change, viz. that from the sensitive to the insensitive state; but, although such must apparently be possible, I have not yet succeeded.

The sudden alteration of the insensitive to the sensitive state is produced in a most marked manner by the spark of a Hertz oscillator at as great a distance as the laboratory room in which I work allows. This distance is usually only about eight or ten feet, but I observed the change effected occasionally when the oscillator was at a distance of some thirty feet or more. In this latter case, however, the action was interfered with by the unavoidable presence of wires along the walls, &c., intervening between the Hertz and my impulsion cell.

If the cause to which I have assigned the change from the photo-electrically insensitive to the photo-electrically sensitive state of the cell is the true one, it is impossible to avoid the speculation that impulsion results of this kind may be very common in the economy of Nature; and that the mode in which solar energy is taken up by plants may be affected, and even altered in kind, by sudden electro-magnetic disturbances. The effect of a Hertz oscillation is, indeed, not confined to an alteration of a plate from the insensitive to the sensitive state; for I have cells in which if the sensitive plate is, on exposure to light, electrically negative to the back plate, a Hertz oscillator at a distance will reverse the relation when the plate is again exposed to light.

GEORGE M. MINCHIN.

Royal Indian Engineering College, Cooper's Hill,
May 10.

P.S.—While the above communication was going through the press, I made an experiment which renders it almost certain that in the impulsion cells the results are due to the formation of some

oscillating layer at the surface of the sensitive plate. Being anxious to keep the alcohol in the cell (which in this instance was closed by a ground glass cap), I sealed the cell into a glass tube through the extremities of which the wires of the cell passed. The effect of the disturbance thus resulting was that no amount of tapping the support of the cell would change it from the sensitive to the insensitive state, although before being thus treated it was sensitive to the most minute disturbance. I suspected, however, that after some hours the liquid and the plate would again enter into the peculiar relation on which the impulsion results depend, and so it turned out—after three hours the cell could be rendered insensitive by taps and sensitive by the inductive effect of a Voss machine. The platinum wires were *soldered* to the plates. I see that the distances at which I found the Hertz oscillator effective in influencing the cells were greater than those above stated; but I have not been able to renew work with the oscillator, which belongs to Mr. Gregory, who removed it for exhibition at the Royal Society's meeting.

May 16.

Bison not Aurochs.

I AM glad that Mr. Lydekker accedes (NATURE, May 15, p. 53) to the correction of which I had pointed out the need. But the "vulgar error"—if the Editor will allow me to use a phrase made classical nearly 250 years ago by Sir Thomas Browne—is of more ancient date than my friend seems to suppose; and Dr. Gadow has kindly referred me to Prof. Wrześniowski's "Studien zur Geschichte des polnischen Tur," published in May 1878 (*Zeitschr. für wissensch.aftl. Zoologie*, xxx. pp. 493-555). Therein will be seen reduced copies of the engravings in an edition of Herberstein's "Rerum Moscoviticarum Commentarii" (Basileæ: 1571), giving a figure of each of the animals. The first is inscribed

VRVS SVM, POLONIS TVR, GERMANIS AVROX:
IGNARI BISONTIS NOMEN DEDERANT.

Over the second may be read

BISONS SVM, POLONIS SVBER, GERMANIS BISONT: IGNARI VRI NOMEN DEDERANT.

This paper is well worth reading from the amount of curious information to be found in it. I have been able to consult only one copy of this work, of an earlier edition indeed, for it was published at Antwerp in 1557; but it does not contain these figures, though the passages quoted by the Polish Professor of course occur (*ff.* 117 *verso et seqq.*). The figures are not remarkable for beauty, and if anyone were to call them caricatures I should hardly complain; but they are certainly of interest, and that of the Urus, which I think I have seen copied elsewhere, is perhaps the only approach to an original representation extant. If so it deserves to be better known. Allow me to remark that this is not the first time that I have noticed this error. I did so many years ago in a little pamphlet "On the Zoology of Ancient Europe" (p. 14), published by Messrs. Macmillan in 1862; and I may add that any visitor to the Museum of Zoology of this University may see therein a skeleton of the Aurochs and of the Bison, as well as of the American "Buffalo"—all standing side by side.

ALFRED NEWTON.

Magdalene College, Cambridge, May 18.

Sudden Rises of Temperature.

IN NATURE, vol. xli. p. 550, it is stated that sudden rises of temperature of large amount in Great Britain "are more frequent and more extensive in amount than sudden falls—the reverse to what obtains in India." There appears to be a somewhat similar condition of affairs in North America. Extremely sudden and large rises of temperature attend the warm Chinook winds, as they are called, which occur over the western part of the continent, but are unknown further east. Equally pronounced are the sudden falls of temperature in the eastern half of the country popularly termed "cold waves."

M. A. VEEDER.

Lyons, N.Y., May 7.

Coral Reefs, Fossil and Recent.

IN Dr. von Lendenfeld's communication to NATURE of May 8 (p. 30), occurs the following:—

"Dr. Murray goes on to say . . . and an isolated atoll rising precipitously, perhaps 10,000 feet from the sea-bottom, will be formed." And again—"and far less will it enable an atoll rising 10,000 feet or more from the bottom of the sea . . ."

I cannot think that the author quoted has committed himself to any such figures as these, but if either he or Dr. von Lendenfeld can tell me where to find such a formation in existing seas, I shall be obliged; as I have sought in vain for instances yet known of any slopes that could be called "*steep*" descending to more than 4000 feet or so, while *precipitous* slopes are unknown to me beyond 1200 feet; and these are, so far as I know, very exceptional.

While I am writing on this subject, I should be glad if anyone would explain how, on the assumption that atolls are formed during subsidence, it comes about that, while the outer slopes descend to great depths, the depth of the largest lagoons inclosed is generally confined to about 45 fathoms, and in one or two cases to 60 fathoms, but is never more. Why should not the lagoon of an atoll twenty or thirty miles in diameter, which rises steeply from depths of 200 or 300 fathoms or more, have a depth of at any rate 100 fathoms, allowing for the most extravagant amount of silt from the *débris* of the rim.

W. J. L. WHARTON.

Doppler's Principle.

A COMPLETE solution of the questions about which your correspondents are puzzling themselves has been before the public for some ten years in several successive editions of my "Deschanel." It occurs in the last paragraph of the chapter entitled "Numerical Evaluation of Sound," and is as follows:—

"Let the source make n vibrations per second. Let the observer move towards the source with velocity a. Let the source move away from the observer with velocity a'. Let the medium move from the observer towards the source with velocity m, and let the velocity of sound in the medium be v.

"Then the velocity of the observer relative to the medium is $a - m$ towards the source, and the velocity of the source relative to the medium is $a' - m$ away from the observer. The velocity of the sound relative to the source will be different in different directions, its greatest amount being $v + a' - m$ towards the observer, and its least being $v - a' + m$ away from the observer. The length of a wave will vary with direction, being $\frac{1}{n}$ of the velocity of the sound relative to the source. The length of those waves which meet the observer will be $\frac{v + a' - m}{n}$, and the velocity of these waves relative to the observer will be $v + a - m$; hence the number of waves that meet him in a second will be $\frac{v + a - m}{v + a' - m} n$."

The three quantities a, a', m may of course be either positive or negative.

J. D. EVERETT.

5 Princess Gardens, Belfast, May 17.

THE SHAPES OF LEAVES AND COTYLEDONS.[1]

ATTEMPTS to explain the forms, colours, and other characteristics of animals and plants, though not new, were until recent years far from successful. Our Teutonic forefathers had a pretty story which explained certain characteristics of several common plants.

Balder, the God of Mirth and Merriment, was, characteristically enough, regarded as deficient in the possession of immortality. The other divinities, fearing to lose him, petitioned Thor to make him immortal, and the prayer was granted on condition that every animal and plant would swear not to injure him. To secure this object, Nanna, Balder's wife, descended upon the earth. Loki, the God of Envy, attended her disguised as a crow (crows at that time were white), and settled on a little blue flower, hoping to cover it up so that she might overlook it. The flower, however, cried out "Forget-me-not, forget-me-not" (and has ever since been known under that name). Loki then flew up into an oak and sat on a mistletoe. Here he was more successful. Nanna carried off the

[1] Lecture delivered at the Royal Institution on April 25, by Sir John Lubbock, Bart., M.P., D.C.L., F.R.S., &c.

oath of the oak, but overlooked the mistletoe. She thought, however, and the divinities thought, that she had successfully accomplished her mission, and that Balder had received the gift of immortality.

One day, thinking Balder proof, they amused themselves by shooting at him, posting him against a holly. Loki tipped an arrow with a piece of mistletoe, against which Balder was not proof. This unfortunately pierced him to the heart, and he fell dead. Some drops of his blood dropped on the holly, which accounts for the redness of the berries; the mistletoe was so grieved that she has ever since borne fruit like tears, and the crow, whose form Loki had taken, and which till then had been white, was turned black.

This pretty myth accounts for several things, but is open to fatal objections. You will judge whether I am more fortunate. In the first place I need hardly observe that the forms of leaves are almost infinitely varied. To quote Ruskin's vivid words, they "take all kinds of strange shapes, as if to invite us to examine them. Star-shaped, heart-shaped, spear-shaped, arrow-shaped, fretted, fringed, cleft, furrowed, serrated, sinuated, in whorls, in tufts, in spires, in wreaths, endlessly expressive, deceptive, fantastic, never the same from footstalk to blossom, they seem perpetually to tempt our watchfulness, and take delight in outstripping our wonder."

Now, why is this marvellous variety, this inexhaustible treasury of beautiful forms? Does it result from some innate tendency of each species? Is it intentionally designed to delight the eye of man? Or has the form and size and texture some reference to the structure and organization, the habits and requirements, of the whole plant?

The leaf, although so thin, is no mere membrane, but is built up of many layers of cells, and the interior communicates with the external air by millions of little mouths, called stomata, which are generally situated on the under side of the leaf. The structure of leaves varies as much as their forms.

It is, of course, principally in hot and dry countries that leaves require protection from too much evaporation.

The surface is in some cases protected by a covering of varnish, in others by saline or calcareous excretions. In others, again, the same object is attained by increased viscidity of the sap; in some, the leaves assume a vertical position, thus presenting a smaller surface to the rays of the sun. In other cases the leaves become fleshy. Woolly hairs are also a common and effective mode of protection. The plants of deserts are very frequently covered with a thick felt of hair. Some species, again, which are smooth in the north tend to become woolly in the south. Species of the cool spring again tend to be glabrous. The uses of hairs to plants are indeed very various. They serve, as just mentioned, to check too rapid evaporation. They form a protection for the stomata or breathing holes, and consequently, as these are mainly on the under side of leaves, we find that when one side of the leaf is covered with white felted hairs, as the white poplar, this is always the under size.

In other cases the use of hair is to throw off water. In some Alpine and marsh plants this is important. If the breathing holes became clogged with moisture—with fog, for instance, or dew—they would be unable to fulfil their functions. The covering of hair, however, throws off the moisture, and thus keeps them dry. Thus these hairs form a protection both against too much drought, and too much moisture.

Another function of hairs which cannot be omitted is to serve as shades against too brilliant light, and too much heat. Again, hairs serve as a protection against insects, and even against larger animals. The stinging hairs of the common nettle are a familiar example, and coarse woolly hairs are often distasteful to herbivorous quadrupeds.

Deciducus leaves especially characterize the comparatively cool and moist atmosphere of temperate regions. For different reasons evergreen leaves become more numerous in the Alps and in the tropics.

In the Alps it is necessary for plants to make the most of the short summer. Hence, perennial and evergreen species are more numerous in proportion than with us. Everybody must have noticed how our trees are broken if we have snow early in the season and when they are still in leaf.

The comparatively tough and leathery leaves, such as those of the evergreen oak and olive, are protected against animals by their texture, and often, as in the holly, by spines; they are better able to resist the heat and dryness of the south than the comparatively tender leaves of our deciduous trees, which would part too rapidly with their moisture. It is perhaps an advantage to evergreen leaves to be glossy, because it enables them better to throw off snow. Moreover, their stomata are often placed in pits, and protected with hair, which prevents too rapid evaporation. The texture and structure of leaves is indeed a wide and very interesting subject, but to-night I must confine myself to the shape.

It is impossible to classify plants by the form of the leaf, which often differs greatly in very nearly allied species. Thus the common plantain of our lawn (*Plantago major*) has broad leaves, *P. lanceolata* narrow ones. The width or narrowness of leaves depends on various considerations. In herbaceous and stalkless plants, such as the plantain, prostrate leaves tend to be broad, those which are upright to be narrow. Thus, grasses, for instance, have more or less upright narrow leaves.

In other cases the width is determined by the distance between the buds, and in others again by the number of leaves in a whorl.

Cordate and Lobed Leaves.

Among broad leaves we may observe two distinct types, according as they are oval or palmate. Monocotyledonous plants, such as grasses, sedges, lilies, hyacinths, very generally have upright and narrow leaves. When they are wider, as, for instance, in the black bryony, this is mainly at the base, where, consequently, the veins are further apart, coming together again towards the apex. This we are tempted therefore to regard as the primitive type of a broad leaf.

There is, however, a totally different one, where the leaf is palmate, like a hand, widening towards the free end. Here the veins pursue a straight, diverging course; and as they not only serve to strengthen the leaf, but also to carry the nourishment, this is doubtless an advantage. Another reason perhaps for this arrangement is found in the fact that these leaves are generally folded up, like a fan, while they are in the bud.

I have elsewhere dwelt on the case of the beech, and perhaps I may briefly refer to it again. The weight of leaves which a branch can carry will of course depend on its position and strength. The mode of growth of the beech and the hornbeam are very similar, but the twigs of the latter are slenderer, and the leaves smaller. If we cut off a beech branch below the sixth leaf we shall find that the superficial leaf area which it carries is about 18 square inches. But in our climate most leaves are glad of as much sunshine as they can secure, and are arranged with reference to it. The width of the beech leaves, about $1\frac{3}{4}$ inch, is regulated by the average distance between the buds. If the leaves were wider they would overlap. If they were narrower there would be a waste of space. The area on the one hand, and the width on the other, being thus determined, the length is fixed, because, to secure an area of 18 inches, the width being about $1\frac{3}{4}$ inch, the length must be about 2 inches. This, then, explains the form of the beech leaf.

Let us apply these considerations in other cases. I

will take, for instance, the Spanish chestnut and the black poplar. In the Spanish chestnut the stem is much stronger than that of the beech. Consequently it can carry a greater leaf-surface. But the distance between the buds being about the same the leaves cannot be much wider; hence they are much longer in proportion, and this gives them their peculiar sword-blade-like shape.

Now, if we look at the end of a branch of black poplar and compare it with one of white poplar, we are struck with two things: in the first place, the branch cannot be laid out on a sheet of paper so that the leaves shall not overlap; the leaves are too numerous and large. Secondly, in the white poplar the upper and under surfaces of the leaf are very different, the lower one being covered with a thick felt of hair, which gives it its white colour; in the black poplar, on the other hand, the two surfaces are nearly similar.

These two characteristics are correlated, for while in the white poplar the leaves are horizontal, in the black poplar, on the contrary, they hang vertically. Hence the two surfaces are under very similar conditions, and consequently present a similar structure; while for the same reason they hang free from one another.

Let us again look for a moment at the great group of Conifers. Why, for instance, do some have long leaves and some short ones? This, I believe, depends on the strength of the twigs and the number of years which the leaves last; long leaves dropping after one, two, or three years, while species with shorter ones retained them many years—the spruce fir, for instance, 8 or 10, *Abies Pinsapo* even as many as 18.

[Here Sir John dwelt on and explained the forms of several familiar leaves.]

Seedlings.

I now come to the second part of my lecture—the forms of cotyledons. Anyone who has ever looked at a seedling plant must have been struck by the fact that the first leaves differ entirely from those which follow—not merely from the final form, but even from those which immediately follow. These first leaves are called cotyledons. The forms of many cotyledons have been carefully described, but no reason had been given for the forms assumed, nor any explanation offered why they should differ so much from the subsequent leaves. Klebs, indeed, in his interesting memoir on "Germination," characterizes it as quite an enigma.

Mustard and cress were the delight and wonder of our childhood, but it never then occurred to me at least to ask why they were formed as they are. So they grew, and beyond that it did not occur to me, nor I think to most, that it was possible to inquire. I have, however, I think, suggested plausible reasons in many cases, some of which I will now submit for your consideration. Cotyledons differ greatly in form.

Some are narrow, in illustration of which I may mention the fennel and ferula, in the stalk or ferule of which Prometheus is fabled to have brought down fire from heaven.

Some are broad, as in the beech and mustard. Moreover, some species have narrow cotyledons and broad leaves, while others have broad cotyledons and narrow leaves.

Some are emarginate, as in the mustard; lobed, as in the lime; bifid, as in Eschscholtzia; trifid, as in the cress; or with four long lobes, as in Pterocarya.

Some are unequal, as in the mustard; or unsymmetrical, as in the geranium.

Some are sessile, and some are stalked; some are large, some small.

Generally, they are green, leaf-like, and aërial, but sometimes they are thick and fleshy, as in the oak, nut, walnut, peas, beans, and many others, in which they never quit the seed at all.

Let us see, then, whether we can throw any light on these differences, and why they should be so unlike the true leaves.

If we cut open a seed, we find within it the future plant: sometimes, as in the larkspur, a very small oval body; sometimes, as in the ash, or the castor-oil, a lovely little miniature plant, with a short stout root and two well-formed leaves, inclosing between them the rudiment of the future stem; the whole lying embedded in food-material or perisperm; while sometimes the embryo occupies the whole interior of the seed, the food-material being stored up, not round, but in the seed-leaves or cotyledons themselves. Peas and beans, almonds, nuts, and walnuts are familiar cases. In split peas, for instance,—who split the peas? If you look at them you will see that it is too regularly and beautifully done for human hands. In fact, the two halves are the two fleshy cotyledons: strictly speaking, they are not split, for they never were united.

Narrow Cotyledons.

Let us now begin with such species as have narrow cotyledons, and see if we can throw any light on this characteristic. The problem is simple enough in such cases as the plane, where we have, on the one hand, narrow cotyledons, and, on the other hand, a long narrow seed fully occupied by a straight embryo. Again, in the ash, the cotyledons lie parallel to the longer axis of the seed, which is narrow and elongated. Such cases are, however, comparatively few; and there are a large number of species in which the seeds are broad and even orbicular, while yet the cotyledons are narrow.

In these it will generally be found that the cotyledons lie transversely to the seed.

The sycamore has also narrow cotyledons, but the arrangement is very different. The fruit is winged, the seed somewhat obovoid and aperispermic—that is to say, the embryo, instead of lying embedded in food-material, occupies the whole cavity of the seed. Now, if we wished to pack a leaf into a cavity of this form, it would be found convenient to choose one of a long strap-like shape, and then roll it up into a sort of ball. This is, I believe, the reason why this form of cotyledon is most suitable in the case of the sycamore.

Broad Cotyledons.

I now pass to species with broad cotyledons. In the castor-oil plant, Euonymus, or the apple, for instance, the young plant lies the broad way of the seed, and the cotyledons conform to it. In the genus Coreopsis, *Coreopsis auriculata* has broad cotyledons, and *Coreopsis filifolia* has narrow ones—the first having broad, the second narrow seeds.

In a great many species the cotyledons are emarginate—that is to say, they are more or less deeply notched at the end. This is due to a variety of causes. One of the simplest cases is that of the oak, where the two fleshy cotyledons fill the seed; and as the walls of the seed are somewhat thickened at the end, and project slightly into the hollow of the seed, this causes a corresponding depression in the cotyledons.

In such cases as the mustard, cabbage, and radish, the emargination is due to a very different cause. The seed is oblong, thick, and slightly narrower at one end than the other. There is no perisperm, so that the embryo occupies the whole seed, and as this is somewhat deep, the cotyledons, in order to occupy the whole space, are folded and arranged one over the other like two sheets of note-paper, the radicle being folded along the edge. To this folding the emargination is due. If a piece of paper be taken, folded on itself, cut into the form of the seed, and then unfolded, the reason for the form of the cotyledon becomes clear at once.

But it may be said that in the wallflower the seed has a

similar outline, and yet the cotyledons are not emarginate. The reason of this is that in the wall-flower, Cheiranthus, the seed is more compressed than in the mustard and radish, and consequently the cotyledons are not folded; so that the whole, not the half, of each cotyledon corresponds to the form of the seed.

Lobed Cotyledons.

The great majority of cotyledons are entire, but some are more or less lobed. For instance, those of the mallow are broadly ovate, minutely emarginate, cordate at the base, and three-lobed or angled towards the apex, with three veins, each running into one of the lobes.

The embryo is green, curved, and occupies a great part of the seed. The cotyledons are applied face to face; then, as growth continues, the tip becomes curved and depressed into a median longitudinal furrow, the fold of the one lying in that of the other.

[Sir John then showed clearly by diagrams and paper how the emargination arises, but it cannot be made clear without illustrations.]

The cotyledons of the lime are very peculiar. They are deeply five-lobed, the central lobe being the longest; so that they are roughly shaped like a hand. The seed is an oblate spheroid, resembling an orange in form, and the embryo is embedded in semi-transparent albumen.

The embryo is at first straight; the radicle is stout and obtuse; the cotyledons ovate-obtuse, plano-convex, fleshy, pale green, and applied face to face. They grow, however, considerably, and when they meet the wall of the seed, they bend back on themselves, and then curve round, following the general outline of the seed. If anyone will take a common tea-cup and try to place in it a sheet of paper, the paper will, of course, be thrown into ridges. If these ridges be removed and so much left as will lie smoothly inside the cup, it will be found that the paper has been cut into lobes more or less resembling those of the cotyledons of Tilia. Or if, conversely, a piece of paper be cut into lobes resembling those of the cotyledons, it will be found that the paper will fit the concavity of the cup. The case is almost like that of our own hand, which can be opened and closed conveniently owing to the division of the five fingers.

Unequal Cotyledons.

In most cases the two cotyledons are equal, but there are several cases in which one of them is larger than the other. They had not escaped the attention of Darwin, who attributed the difference to the fact "of a store of nutriment being laid up in some other part, as in the hypocotyl, or one of the cotyledons." I confess that I do not quite see how this affords any explanation of the fact. The suggestion I have thrown out is that the difference is due to the relative position of the two cotyledons in the seed, which in some cases favours one of them at the expense of the other. Thus in the mustard they are unequal, and, as we have already seen, they are folded up, one inside the other. The outer one, therefore, has more space, and becomes larger. In many other Crucifers, though the cotyledons are not folded, they are what is called "incumbent"—that is to say, they are folded on the radicle, and the outer one has therefore more room than the other.

Unsymmetrical Cotyledons.

In other cases, as in the geraniums, laburnum, lupines, &c., there is inequality, not between the two cotyledons, but between the two halves of each cotyledon. In the geraniums this is due to the manner in which the cotyledons are folded. In cabbage and mustard we have seen that one cotyledon is folded inside the other; in the geranium they are convolute, one half of each being folded inside one half of the other, the two inner halves being the smaller, the two outer the larger ones.

In the laburnum, where the arrangement is very similar, the inequality in the two sides of the cotyledon is due to the inequality between the two sides of the seed.

Subterranean Cotyledons.

I have already observed that in some cases the cotyledons occupy the whole of the seed, which, in more or less spherical seeds is effected either by a process of folding and packing, or by the cotyledons becoming themselves more or less thickened, as in peas and beans, nuts and chestnuts. This is the reason why such seeds fall more or less readily into two halves, the radicle or plumule being so small in comparison as generally to escape notice, though, if a horse-chestnut is peeled, the radicle appears as a sort of tail.

In some beans the cotyledons sometimes emerge from the seed, sometimes remain underground. In others, as also in the oak and horse-chestnut, they never leave the seed, or come above ground: they have lost the function of leaves and become mere receptacles of nourishment.

Did it ever occur to you to think, when you have been eating walnuts, why their structure is so complex, and why the edible part is thrown into those complicated lobes and folds? The history is very interesting.

In the walnut, the cotyledons now never leave the seed, but in an allied genus, Pterocarya, they come above ground as usual, and are very peculiar in form, being deeply four-lobed. The reason of this is very curious. The fruit is originally much larger than the seed, but, as it approaches maturity, the hard woody tissue disintegrates at four places, leaving thus four hollow spaces. Into these spaces the seed sends four projections, and into these four projections each cotyledon sends a lobe. Hence the four lobes.

Now in the walnut a very similar process takes place, only the hollow spaces are much larger, so that, instead of a solid wall, with hollow spaces occupied by the seed, it gives the impression as if the seed was thrown into folds occupied by the wall of the fruit. To occupy these spaces fully, the cotyledons themselves were thrown into folds as we now see them. The fruit of Pterocarya is much smaller than that of the horse-chestnut, which doubtless was itself formerly not so large as it now is. As it increased, the cotyledons became fleshier and fleshier, and found it more and more difficult to make their exit from the seed, until at last they have given up any attempt to do so. Hence these curious folds, with which we are so familiar, are the efforts made by the originally leafy cotyledons to occupy the interior of the nut. If you separate them, you will easily find the little rootlet, and the plumule with from five to seven pairs of minute leaves.

But perhaps you will ask me why I have assumed that in these cases the cotyledons have conformed to the seeds? May it not be that the seed is determined, on the contrary, with reference to the cotyledons? The size, form, &c., of the seeds, however, evidently have relation to the habits, conditions, &c., of the parent plant.

Let me, in illustration, take one case. The cotyledons of the sycamore are long, narrow, and strap-like; those of the beech are short, very broad, and fan-like. Both species are aperispermic, the embryo occupying the whole interior of the seed.

Now, in the sycamore, the seed is more or less an oblate spheroid, and the long ribbon-like cotyledons, being rolled up into a ball, fit it closely, the inner cotyledon being often somewhat shorter than the other. On the other hand, the nuts of the beech are more or less triangular: an arrangement like that of the sycamore would therefore be utterly unsuitable, as it would necessarily leave great gaps. The cotyledons, however, are folded up like a fan, but with more complication, and in such a manner that they fit beautifully into the triangular nut.

Can we, however, carry the argument one stage further? Why should the seed of the sycamore be globular, and that of the beech triangular? Is it clear that the cotyledons are constituted so as to suit the seed? May it not be that it is the seed which is adapted to the cotyledons? In answer to this we must examine the fruit, and we shall find that in both cases the cavity of the fruit is approximately spherical. That of the sycamore, however, is comparatively small, say $\frac{1}{5}$ inch in diameter, and contains one seed, which exactly conforms to the cavity in which it lies. In the beech, on the contrary, the fruit is at least twice the size, and contains from two to four fruits, which consequently, in order to occupy the space, are compelled (to give a familiar illustration, like the segments of an orange) to take a more or less triangular form.

Thus, then, in these cases, starting with the form of the fruit, we see that it governs that of the seed, and that of the seed, again, determines that of the cotyledons. But though the cotyledons often follow the form of the seed, this is not invariably the case: other factors must also be taken into consideration; but when this is done, we can, I venture to think, throw much light on the varied forms which seedlings assume.

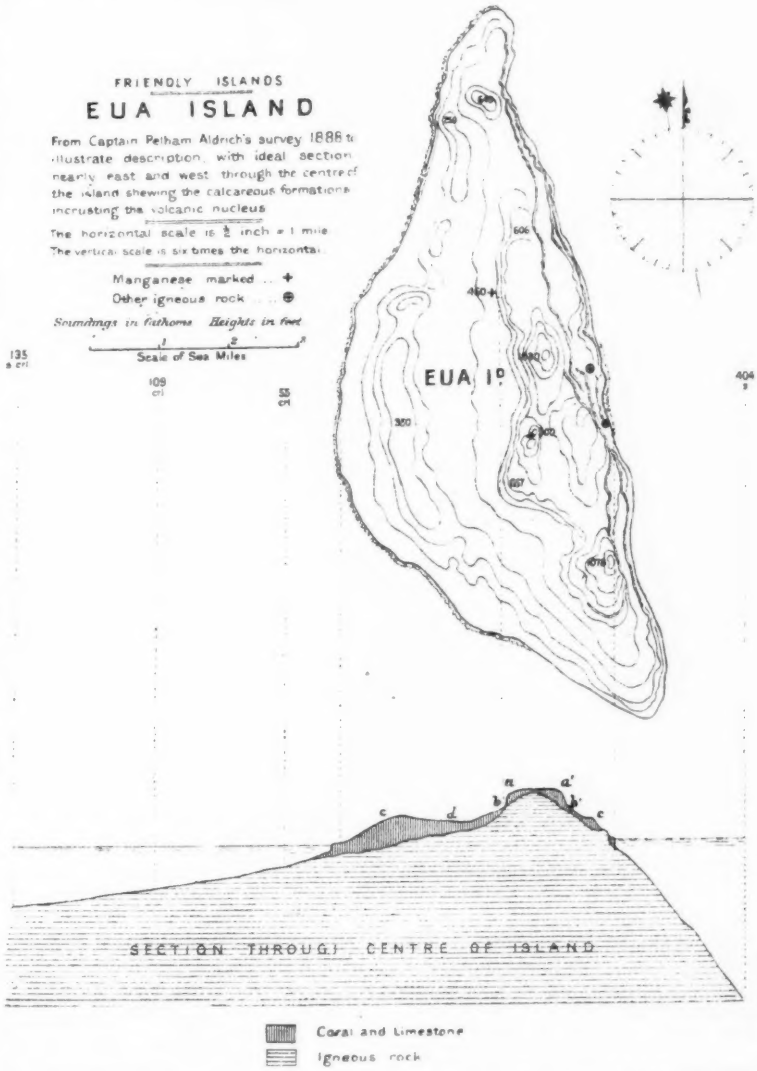
I have thus attempted to indicate some of the principles on which, as it seems to me, the shapes of leaves and seedlings depend, and to apply them in certain cases, but the study is only in its infancy: the number and variety of leaves is almost infinite, and the whole question offers, I venture to think, a very interesting field for observation and research—one, indeed, of the most fascinating in the whole of natural history.

EUA ISLAND, TONGA GROUP.

THE following description of Eua Island (one of the higher members of the Friendly or Tonga Islands, and familiar to readers of "Cook's Voyages" as Middleburgh), written by Commander Oldham, of H.M. surveying-ship *Egeria*, will be of interest to geologists and those interested in the coral controversy.

W. J. L. WHARTON.

"When viewed from the westward, Eua is seen to consist of grassy table-lands and slopes, having clumps of dark-green trees dotted here and there, giving it a park-like appearance. It is formed of two coral terraces resting on a volcanic nucleus. The upper terrace, about 600 feet above the level of the sea, rises to a summit 1030 feet high; the lower terrace attains a height of only 350 feet. On the western side of the island these terraces are separated a distance of from one to one and a half miles, and in some places there is a depression between them; the eastern side is very precipitous, the terraces there being very narrow, and forming cliffs at their seaward edges.



"The upper terrace seems composed of foraminiferous limestone and reef rock, with volcanic rock (a hydrated oxide of manganese) cropping out on the western side at the edge of the terrace where the coral rock has been removed by the effects of weather. The limestone is compact, reddish-brown, and largely foraminiferous. It is both *in situ* and scattered in detached blocks over the upper terrace, and when weathered has a honeycombed appearance.

"Low coral cliffs, which in many places form the shore-line, give indications of recent elevation, being marked by two distinct lines of erosion. On the beach, on the eastern side of the island, I observed that the sea had washed up recently high above the ordinary high-water mark; trunks of cocoa-nuts were lying about rotting, and the lower part of the stems of those still standing near the shore had been washed by salt water. This was afterwards explained by the fact that a very high tide occurred on March 18 (about the time of the hurricane at Samoa), which rose 2 feet above high-water mark, and remained so for fifteen minutes. A narrow fringing reef generally borders the island. On the eastern side of the island, below the summit, at an elevation of 300 feet, volcanic stones were observed lying in the bed of a stream, and on the beach, a little further south, are dykes of volcanic rock; one of diorite shows through the beach, another, which is close-to, is about 100 feet high, and can be traced a short distance inland. The inner part has *coral-reef rock, conformable, superimposed.* The beach for a considerable distance either side is strewn with blocks of conglomerate formed of coral and volcanic rocks cemented together.

"The higher part of the lower terrace on the western side of the island was found to be composed of coral-reef rock.

"The present volcanic nucleus must have been originally below the surface, but sufficiently near to allow coral to grow, and reef-making Foraminifera to be deposited on its summit. It was then evidently elevated about 300 feet (marked *aa'*, *bb'* in section) in a comparatively short interval, after which a long period of rest, or subsidence, followed, during which coral grew (forming the portion *bb'* to *cc'*), and a lagoon (*d*) was produced. Then another period of elevation raised the island to its present height, and exposed the volcanic foundation.

"C. F. OLDHAM."

I am indebted to Captain Wharton for sending me the specimens collected by Commander Oldham. The limestones, some of which are fairly crystalline in character, are composed of Foraminifera and water-worn fragments of calcareous Algæ ("Nullipores"). The deposit of hydrated manganese oxide cropping out from below the limestone is remarkable, but it has all the appearance of an ordinary terrestrial deposit. A much-weathered mass from the neighbourhood contains many beautiful crystals of magnetite. Although the rocks forming the nucleus of the island are of igneous origin, they are not modern volcanic materials. They consist of much altered glassy andesites (porphyrites) with epidiorites; and are suggestive of ancient volcanic masses that have been exposed at the surface by denudation. The significance of such facts as these has been pointed out by Prof. Bonney and Dr. Blanford; and it is quite incorrect to quote examples like this as lending support to the view that all oceanic islands are of volcanic origin. JOHN W. JUDD.

NOTES.

IN the list of Birthday honours the merits of many different classes of public servants are duly recognized. The services of men of science in the Science and Art Department, however, following an unbroken rule, fail to receive any acknowledgment.

AMONG those who have received the honour of C.B., we are glad to see the name of Prof. W. C. Roberts-Austen, F.R.S., Assayer to the Royal Mint.

THE date of the second *soirée* of the Royal Society, to which ladies are invited, is fixed for June 18.

THE Jubilee of the Uniform Penny Post was well and worthily celebrated at the Guildhall on Friday last, the 16th inst., by the Corporation of the City of London. The grand old hall was never applied to a better purpose. Every process connected with Post Office work, from telegraphy to sorting, was shown in actual operation. The Exhibition remained open for three days, and 25,000 people were delighted.

ON May 15 an influential deputation from the Marine Biological Association of the United Kingdom waited upon the Chancellor of the Exchequer to ask for an additional grant from the Treasury in aid of investigations in connection with food-fishes, crustacea, and mollusks, carried on by the Association. Mr. Joseph Chamberlain, M.P., introduced the deputation. Both he and Sir E. Birkbeck, M.P., called Mr. Goschen's attention to the large amount spent by the United States in the encouragement of the fishing industry; and Sir E. Birkbeck pointed out that even Scotland, with her grants to the Scotch Fishery Board, is in this respect ahead of England. After some remarks from other members of the deputation, the Chancellor of the Exchequer, in reply, said that the questions which had been put by him in the course of the speeches were not made from a critical or carping point of view, but merely to convince himself as to what were really the aims of the Association, which he regarded as excellent; but he could not say anything as to the practicability of their being carried out. He pointed out that the Treasury would very carefully consider the whole question of how to recast the Fisheries Department, but he felt that it would be an inconvenient thing to have four bodies, two in England and one each in Scotland and Ireland, whose jurisdiction might overlap. He hoped to be able in a short time to have an opportunity of consulting some of the scientific and other gentlemen present, in order to have further light thrown upon the subject before the Government took any action in the matter.

AT the Royal Institution, on Tuesday afternoon, May 27, Mr. Andrew Lang will begin a course of three lectures on "The Natural History of Society." The remaining lectures will be given on June 3 and 10.

MR. G. BERTIN is about to deliver, at the British Museum, a series of four lectures on the manners and customs of the Babylonians, from the cuneiform documents in the Museum. The lectures will be given on the following Tuesdays—June 3, 10, 17, and 24, at 3.30 p.m.

ON Monday evening Mr. T. W. Russell asked in the House of Commons whether the Committee consisting of certain members of the Royal Society appointed to inquire into the question of lighthouse illuminants had yet reported. Sir M. Hicks-Beach replied that there had been some unavoidable delay in the matter in consequence of a change made in the composition of the Committee. But he had communicated with the President of the Royal Society, and understood that the Report of the Committee might be expected in the course of the summer.

MR. F. H. SNOW, of Lawrence, Kansas, calls attention in *Science* to a remarkable fall of meteorites of unknown date in Kiowa County, Kansas. "Many of the citizens of Greensburgh, the county seat, were," he says, "aware of the existence of these strange irons, and commonly called them meteoric; but there seems to have been no suspicion of their true character and value. Indeed, until March 17, 1890, a specimen weighing 101·5 pounds, had ornamented the side-walk in front of a real estate office in the above-named town for about three years. The farmers in the vicinity of the locality where the fall had occurred had put some of the specimens to various uses." Prof. W. Cragin, of Washburn College, was the first scientific man who visited the farm upon which the meteorites had fallen. This was on March 13. He secured from one of the farmers five meteorites, aggregating in weight over a thousand pounds, the

heaviest specimen weighing 466 pounds. Mr. Snow himself shortly afterwards visited the place several times, and obtained five specimens, one of them being the meteorite which had been used as an ornament of a side-walk. The total number of masses included in the fall was at least twenty; and Mr. Snow says that the total weight of all the masses must have exceeded two thousand pounds. They fell within an oval area about one mile in length. "Some of the specimens were only partially buried in the ground; others were struck by the breaking plough at a depth of from three to four inches; others at the second ploughing, five or six inches deep; others yet, by the stirring plough at the third ploughing in a subsequent season." A specimen retained for the museum of the University of Kansas weighed 54·96 pounds. "It is," says Mr. Snow, "an irregular plum-shaped mass, much pitted, and covered with a burned and weathered crust. Its extreme length is about eleven inches, and its breadth is seven inches. This specimen, as well as the others mentioned above, so far as examined by the writer, belongs to that class of meteoric iron known as 'pallasite.' It is composed of nickeliferous iron, including many cavities throughout the entire interior. These cavities are filled with troilite and a yellowish, glassy mineral, which is probably olivine. Some of the latter is very dark and less transparent. The specific gravity, determined by Mr. E. C. Franklin, our assistant in chemistry, and obtained by weighing the whole mass, is 4·76. Two hundred and ninety-three grams have been removed from the larger end of the specimen, and a polished surface of about fifteen square inches has been obtained, which shows very well the structure. The Wiedmanstaeten figures, rather coarse in outline, were developed readily upon the polished iron surface by the application of nitric acid. The portion removed from the specimen is being used for analysis by Prof. E. H. S. Bailey and Mr. E. C. Franklin, and the results of the analysis will appear later."

M. V. FAYOD, of Nervi, near Genoa, has been appointed assistant in the bacteriological laboratory of the Faculty of Medicine in Paris.

THE post of Director of the Botanic Garden at Hamburg, vacant by the death of the late Prof. H. G. Reichenbach, will not at present be filled up: the Garden will remain under the care of the present Inspector, assisted by the botanists Sadebeck and Dingler.

Notarisia is no longer the only botanical journal in Italy devoted to the interests of algology. The first number has been issued of *La Nuova Notarisia*, a quarterly journal with a similar scope, published at Padua, under the editorship of Dr. G. B. De Toni, Director of the Botanic Garden at that University.

THE *Canadian Record of Science* for April records the opening of a botanical laboratory in connection with the McGill University, Montreal, under the control of Prof. D. P. Penhallow. The course of study to be pursued at the laboratory, which is furnished with microtomes, embedding baths, &c., embraces a thorough grounding in vegetable histology, and carries on those students who may desire it to a study of tissues and their constituent elements, and to the complete histology and life-history of plants.

THE Bulletin of the Torrey Botanical Club records that Miss Mary E. Banning has presented to the New York State Museum of Natural History a magnificent volume of illustrations in water-colour, accompanied by manuscript descriptions of about 175 species of the Fungi of Maryland, belonging mostly to the Hymenomycetes and Gasteromycetes.

THE trustees of Columbia College, New York, have adopted a report which, according to the *Nation*, completely reorganizes the College, and puts it definitively on the footing of a University, with faculties of philosophy, political science, mines, and law, each independent in its own sphere, but working under a University Council, made up of representatives of each faculty, and of some selections made by the President. The University will give the Master's and Doctor's degrees, and the Council will "advise the President as to all matters affecting these degrees, the correlation of courses, the extension of University work in new and in old fields, and generally as to such matters as the President may bring before it." The *Nation* attributes much importance to this change, which, it thinks, "must have the effect of stimulating the love of culture among the undergraduates, of making the University, more than ever, what all our colleges ought to be, but what only a few really are, a seat of learning."

GREAT efforts are being made in the United States to secure that American industrial products shall be well represented at the forthcoming Jamaica International Exhibition. A Committee has been appointed to make all necessary arrangements; and one of the advantages already obtained for exhibitors is that low freight rates will be charged for exhibits.

THE Smithsonian Institution has issued the tenth of the Toner Lectures, which have been established at Washington by Dr. Joseph M. Toner, of that city, for the promotion of medical science. The new lecture is by Dr. Harrison Allen, and is entitled "A Clinical Study of the Skull." It is described by the author as "a contribution to the morphological study of diseased action." He expresses a hope that the results he has expounded may excite increasing interest in the proposition that "medicine for the most part is a science based on biology." "The study of biology," he says, "should not be the preparatory work of the tiro only, but should be the subject of increasing assiduity in every phase of medical work. The study of anatomical variation in the human frame is a phase of biology, and it is held in this connection to be a subject as important as any other which may claim the attention of the student of etiology of disease."

THE United States Hydrographic Office has called attention to the fact that the Bordeaux Chamber of Commerce has offered a series of prizes in order to induce masters and officers of vessels to test thoroughly the use of oil at sea. There are three sets of prizes, each set consisting of a first prize of 200 francs and a second prize of 100 francs. These prizes will be awarded for the best reports received by January 31, 1891, based upon actual experience.

ON Monday evening last, at the Surveyors' Institution, London, Mr. R. F. Grantham, M.Inst.C.E., read a paper entitled "The Encroachment of the Sea on some parts of the English Coast, and the best means of arresting it." After bringing forward evidence to show the rate of erosion on various parts of the coast, the author referred to several works for defending the coast-line from encroachment, best adapted for various situations, and described a system of groyning which had been successful for the past twelve years at Shoreham, Sussex, in protecting some land lying below the level of high-water of the tides, and in driving high-water mark further seawards. He suggested that in some instances where shingle travelled along the coast, inasmuch as groynes were necessary to protect sea-walls, the sea-walls might be omitted, and thus a substantial saving in the first cost of protection might be effected.

THE Pilot Chart of the North Atlantic Ocean shows the tracks of nine cyclones during the month of April; only five of these were of noteworthy severity: one, moving between Scotland and Iceland on the 1st and 2nd was the same great storm that gave birth to the tornado which wrecked Louisville on March 27. Another noteworthy cyclone originated north of Bermuda on the 1st, moved north-easterly at the high velocity of about 1080 miles a day, causing terrific gales along the transatlantic routes, and disappeared near Iceland on the 4th. A new feature during the month was the very unusual easterly

movement of the ice, so that, in addition to the large number of bergs south of the Banks, ice was constantly reported almost as far east as the 35th meridian, in latitude 46° and 47° N.

DR. MAX BUCHNER, who has spent a year and 9 months in Australia, Japan, China, and Manilla, has returned to Munich. He has brought back a valuable scientific collection for the Ethnographical Museum, of which he is the director.

Engineer and *Engineering* for May 16 print excellent leading articles on the disastrous accident to the West Coast Scotch express at Carlisle, on March 4; their principal reason being that the Board of Trade Report has just been issued, and that it is in many respects a remarkable document. The accident, as our readers will remember, was due to the driver losing control of the train on entering Carlisle Station, where it ran into a Caledonian engine waiting at the other end of the station. The Report issued by the Board of Trade contains all the available evidence, and the Inspector's opinions as to the cause. The question to be settled was, Why or how did the driver lose control of the train? The Inspector held that the driver was in fault, and this in the face of much evidence that did not support his theory. This evidence he got rid of by the simple expedient of rejecting it as untrue. Our contemporaries clearly demonstrate the real cause of the brake failure, and point out that the Board of Trade Inspector, even after the inquiry, did not understand the construction and working of the North-Western automatic vacuum brake, and that, therefore, his opinion is not worth the paper it is written on. For instance, in his Report he is evidently under the impression that it is possible for the driver to alter the working of the train-brake from automatic to non-automatic working from the foot-plate—an impossibility. The accident was caused by the train-pipe between the engine and train becoming blocked by ice, and thus causing the train-brake to become gradually useless, owing to the connection with the engine being closed. The engine-driver had no means of knowing this state of affairs except by applying the brake, which he did on approaching Carlisle, and found it of no use. The Board of Trade Inspector has thrown the blame of the accident on the driver—a man who, according to the evidence, displayed exceptional presence of mind in what he did. Had the Board of Trade Inspector been a trained railway engineer, he would certainly have come out of this inquiry more satisfactorily. The inquiry, or rather the result of it, distinctly points to the anomaly of officers, however eminent, adjudicating on matters concerning which they have not been thoroughly instructed.

IN the year 1886, when Mr. John Gardiner was scientific adviser to the Board of Agriculture of the Bahamas, he was asked by Governor H. A. Blake to prepare a list of the flora of the colony. At the same time a list of the plants of New Providence, prepared some years before by Mr. L. J. K. Brace, was placed at his disposal. With this as a base, Mr. Gardiner set to work, and in due time his task was accomplished. The list, with notes and additions by Prof. Charles S. Dolley, has now been printed in the Proceedings of the Academy of Natural Sciences of Philadelphia. It is called provisional, as Mr. Gardiner explains in an introductory note, mainly because it is not backed throughout by herbarium specimens.

MR. GEORGE W. PERRY, of Rutland, Vt., writes to *Science* that European furze grows in one spot in the island of Nantucket, where it has maintained itself for fifty years. It was introduced by an Irishman, "who was homesick because it did not grow about his cabin, as in the old country." Mr. Perry believes it has not spread to any great extent. "It may be interesting to some," he adds, "that the Scotch heath also is found in one spot in the island, where it has continued for a long time." Mr. George M. Dawson, of the Geological Survey of Canada, also writes to our American contemporary about gorse or furze in the New World. He says it has for many years been fully naturalized in the southern part of Vancouver Island, where, along road-sides and in waste places near Victoria, it is very common. The broom is also abundant in similar situations in the same locality, and "both plants appear to be as much at home as in their native soil."

THE new number of the Journal of the Anthropological Institute of Great Britain and Ireland contains, among other papers, an interesting address by the President, Dr. John Beddoe, in the course of which he refers to the vexed question as to the original seat of the Aryan race. Speaking of the fact that the Lithuanian language is regarded by some philologists as "the most primitive in form of the whole Aryan family," he points out that we have little definite knowledge as to the physical type of the Lithuanians. "Here, then," he says, "is a fine opportunity, well within reach, for a partisan of the European-origin theory. Let him go to Kovno or Vilna, and bring us back, thoroughly established, the true Lithuanian type."

A DETAILED description of the useful minerals and mineral waters of the Caucasus, by Prof. V. Möller, has appeared at Tiflis. The author is at the head of the Mining Administration of the Caucasus, and has availed himself of all accessible information on the subject. The work is illustrated by a map. It appears as the third volume of the second series of "Materials for the Geology of the Caucasus."

THE U.S. Department of Agriculture has issued Parts I., II., and III., of a valuable "Bibliography of American Economic Entomology." These parts relate to the more important writings of B. D. Walsh and C. V. Riley, and have been prepared by Samuel Henshaw.

MESSRS. CROSBY LOCKWOOD AND SON will publish immediately a new "Pocket Book" for electrical engineers, which has been written by Mr. H. R. Kempe, of the Postal Telegraphs Department. They have also nearly ready a new work on "Electric Light Fitting," a practical hand-book for working electrical engineers, by Mr. John W. Urquhart, whose book on "Electric Light" is well known.

THE same publishers have in the press a new elementary treatise on "Light," for the use of architectural students, by Mr. E. W. Tarn, forming a new volume of "Weale's Rudimentary Series"; also a revised and enlarged edition of Prof. Merivale's "Notes and Formulæ for Mining Students"; and a new edition of Mr. G. W. Usill's "Practical Surveying."

WE understand that Mr. Caleb Pamely, of Pontypridd, has in the press a comprehensive treatise for the use of mining engineers, dealing with the whole subject of colliery working and management. It will be published by Messrs. Crosby Lockwood and Son.

AT a recent meeting at Shanghai of the China Branch of the Royal Asiatic Society, Dr. Macgowan, the veteran scholar, presented a paper on the political domination of women ("gynæcocracy" or "gynarchy") in Eastern Asia. In the opening of the paper reference was made to the condition of the aboriginal peoples whom the Chinese found on the Yellow River on their arrival from Akkad. The Chinese then possessed the rudiments of civilization, of which the aboriginals were destitute. That this irruption of the Chinese was anterior to the invention of cuneiform writing in Akkad was probable, because of their use of quipos or knotted cords in keeping records. These quipos, the author said, and not mere tradition, were the base of Chinese archaic annals, and from them the earliest form of Chinese written characters was evolved. Anterior to these quipos, judging from certain neighbouring tribes, notched sticks were employed. With regard to the tribes which the Chinese

found existing on reaching their future home, Dr. Macgowan remarked that the philosopher of Universal Love, Motzu, proto-altruist and arch-heresiarch—whose sun was rising when the sun of Confucius was setting—enunciated views on the evolution of the state and family which are in accord with those of modern anthropologists. Men at first were in the lowest state of savagery: there was no Golden Age as depicted by sages and political philosophers until men felt the necessity of a remedy for the anarchy that prevailed. Practices of self-deformation were some of them remarkably curious, such as those of drinking through the nostrils, extracting front teeth and substituting dogs' teeth, head-flattening, &c.; the most striking was the attempt to raise a polydactylous race, by destroying all children who came into the world with the usual number of fingers and toes, and thus a tribe had a dozen fingers and as many toes. The writer then described a number of instances of rule by Amazons, and observed that it is chiefly among the aboriginal inhabitants that the chieftaincy of women obtains to this day. There is seldom an age in which one tribe or another does not afford examples; the more primitive the condition of these tribes the slighter is sexual differentiation as regards public governmental affairs, both civil and military. It was owing to rumours respecting tribes of this kind that fables and myths in Greece arose regarding Indo-Scythian Amazons. The paper, which is full of valuable ethnological matter, will be published in the Journal of the Society.

A PAPER upon the spontaneously inflammable liquid hydride of phosphorus, P_2H_4, is communicated by Drs. Gattermann and Haussknecht, of Heidelberg, to the new number of the *Berichte* (p. 1174). Owing to the disagreeable and highly dangerous properties of this substance, its chemical history has never been completed; very little, indeed, has been hitherto added to our knowledge concerning it since its discovery by Thénard in 1845. The Heidelberg chemists have devised a much better mode of preparing the liquid from phosphide of calcium, by means of which it is obtained in a state of almost perfect purity. A Woulfe's bottle with three necks and of about two litres capacity is three parts filled with water. The central tubulus serves to introduce a wide tube of 15 mm. diameter expanded into a funnel at the top and passing down to about three centimetres beneath the water. One of the side necks is fitted with a cork and a bent tube just dipping beneath the surface of the water, through which a current of hydrogen gas can be driven. The third tubulus carries the delivery tube which permits of the escape of first the hydrogen, and afterwards the products of the reaction between the calcium phosphide and the water, into a special form of condensing arrangement. The Woulfe's bottle is placed in a capacious water-bath, which is heated to 60° C. as soon as all the air is expelled by the current of hydrogen. The calcium phosphide is then introduced through the central wide tube in pieces about two grams in weight, until, in about 15–20 minutes' time upwards of 50 grams have been added. The escaping gases pass first through an empty wide test-tube in which most of the admixed water-vapour is condensed, then into an upright tube, narrowed in its lower half, and closed at the bottom, which forms a suitable receptacle for the liquid hydride. By means of an exit-tube the remaining gases are permitted to escape; owing to a little admixed and uncondensed vapour of the liquid, they burn spontaneously at the mouth of the tube. The condenser is surrounded with iced water instead of a freezing mixture, so that the condensation may be observed. In about five minutes after commencing the operation clear colourless highly refractive drops of the liquid form and run down into the narrower portion of the condenser, about 2 c.c. being obtained from 50 grams calcium phosphide. The experiment must not be performed in sunlight, otherwise the liquid rapidly decomposes, in the manner described by Thénard, into gaseous PH_3 and solid P_4H_2. By a slight addition to the above arrangement, all three hydrides of phosphorus may be simultaneously prepared. The escaping gases are allowed to pass through a large flask containing hydrochloric acid, which decomposes the vapour of the remaining liquid hydride, and large quantities of the yellow solid P_4H_2 separate out. The escaping gas, which may be collected over water, is non-spontaneously inflammable, and consists of practically pure PH_3. Liquid P_2H_4 boils constantly and without decomposition when not suddenly heated at 58° under a pressure of 753 mm. Its specific gravity at 12° is 1·007, nearly the same as that of water. Exposed to sunlight it becomes yellow in half an hour, due to the formation of solid P_4H_2, which remains at first dissolved; after 2–3 hours' exposure, the yellow solid begins to separate out, and in 1½ days 0·2 gram is totally decomposed, in accordance with the equation $5P_2H_4 = 6PH_3 + P_4H_2$. Consequently, sealed tubes containing this substance exposed in daylight are very dangerous articles. Owing to the accumulation of PH_3 gas, they are apt to explode with deafening concussion and production of a wide-spreading and very brilliant flame, especially if the drawn-out end becomes accidentally broken off.

THE additions to the Zoological Society's Gardens during the past week include a Wanderoo Monkey (*Macacus silenus* ♀) from the Malabar Coast of India, presented by Miss Eileen Martin; two Leopards (*Felis pardus*) from India, presented by Mr. — Egerton; two Yellow-winged Blue Creepers (*Cæreba cyanea*) from South America, presented by Mr. H. E. Blandford; two Mandarin Ducks (*Æx galericulata* ♂ ♀) from China, presented by Mr. C. J. Kingzett; two —— Touracous (*Corythaix* sp. inc.) from South Africa, presented by Mr. C. W. Burnett; two Undulated Grass Parrakeets (*Melopsittacus undulatus*) from Australia, presented by Mr. A. Golden; two Common Vipers (*Vipera berus*), British, presented respectively by Mr. W. H. B. Pain and Mrs. Mowett; an Australia Peewit (*Lobivanellus lobatus*) from Australia, presented by Capt. Shepherd; a Himalayan Bear (*Ursus tibetanus* ♂), two Bengal Foxes (*Canis bengalensis*), two —— Hares (*Lepus macrotis*) from India, a Ruffed Lemur (*Lemur varius*) from Madagascar, deposited; two Bar-tailed Pheasants (*Phasianus reevesi* ♀ ♀), an Amherst Pheasant (*Thaumalea amherstiæ* ♂) from China, a Variegated Sheldrake (*Tadorna variegata* ♀) from New Zealand, two Black-headed Conures (*Conurus nanday*) from Paraguay, purchased; a Crested Porcupine (*Hystrix cristata*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

OBJECTS FOR THE SPECTROSCOPE.

Sidereal Time at Greenwich at 10 p.m. on May 22 = 14h. 1m. 54s.

Name.	Mag.	Colour.	R.A. 1890.	Decl. 1890.
			h. m. s.	° ′
(1) G.C. 3770	—	White.	13 59 17	+52 54
(2) 69 Virginis	5·5	Yellowish-white.	13 21 35	−15 24
(3) B.A.C. 4693	5	Yellowish-red.	14 3 32	+44 23
(4) 20 Boötis	5	Yellow.	14 14 36	+16 49
(5) *n* Boötis	3	Yellowish-white.	13 49 30	+18 57
(6) U Cygni	Var.	Very red.	20 10 11	+47 33

Remarks.

(1) This very large nebula (101 M Boötis) has not yet been spectroscopically examined. According to the Parsonstown observations, it is at least 14′ across, and exhibits a spiral structure with arms and knots. It is everywhere faint, except in the middle. In the General Catalogue it is described as: "Pretty bright; irregularly round; at first gradually, then very suddenly much brighter in the middle to a small bright nucleus." The

spectrum of such a diffused mass is likely to possess great interest, and the nebula is so large that it will probably not be difficult to differentiate the spectra of different regions.

(2) In his catalogue of stellar spectra, published in 1887, Konkoly records an observation of this star, in which bright lines were strongly suspected. Notwithstanding the recent additions to this group by Prof. Pickering and Mr. Espin, the number is still very small, and it is important that suspected cases should be fully investigated. The lines suspected by Konkoly in 69 Virginis were C, D_3, and F—the three commonly observed in β Lyræ and γ Cassiopeiæ. It is quite possible that the appearance of the lines is periodic, and observations should therefore be continued for some time. If the lines are of any considerable brightness, the observations ought not to be difficult, as the bright lines in the 8th magnitude stars in Cygnus are easily seen and measured with 10 inches aperture. Any irregularities in the continuous spectrum, especially in the green and blue, should be noted; and, if possible, comparisons should be made with the carbon flutings. Prof. Lockyer has pointed out that a line near λ 447 is associated with D_3 in the Orion nebula, and also in the solar chromosphere, and it is important to observe whether this also applies to the bright-line stars. He has demonstrated by photographs that the line in the nebula (447) is coincident with one of the bright lines photographed by Prof. Pickering in P Cygni.

(3) Dunér describes the spectrum of this star as a magnificent one of Group II., particularly in the red end. The bands 1–9 are all strongly marked. The star is thus probably a little more advanced in condensation than the mean species of the group, and it will be interesting to know what line-absorptions appear at this stage, and also what is the extent of carbon radiation.

(4 and 5) These are given in Vogel's catalogue as stars of the solar type and of Group IV. respectively. The usual observations are required in each case.

(6) This is one of the very few variables with spectra of Group VI. So far, we have no records of any changes in spectra which may accompany the variations in magnitude, and the cause of the variability is, consequently, very imperfectly understood. Dunér says that the spectrum consists of three zones rather feebly developed, band 6 (near λ 564) being weak, but he does not state the magnitude of the star at the time of his observation. The next maximum will occur about May 28. The star ranges from about magnitude 7·5 to < 11 in a period of 461 days. Changes of colour should also be noted.

A. FOWLER.

SPICA.—At the Berlin Academy of Sciences on April 24, Prof. Vogel announced that Spica consists of two close stars revolving round their common centre of gravity. The star's spectrum is that of Class IV., and twice in April 1889 the F line appeared to be shifted towards the violet end of the spectrum as compared with the H β line given by a vacuum tube, whilst once in the following month the shift appeared to be towards the red end. These observations and others made this year of the star's motion in line of sight are given in the following table, approach to the sun being indicated by (−) and recession from the sun by (+), both being expressed in German miles per second :—

Potsdam Mean Time.	h.	m.	Observed Motion	Relative to the Sun.	*-·
1889 April 21 ...	9	15	... −11·6	... −0·7	... −12·3
,, 29 ...	11	10	... −12	... −1·2	... −13·2
May 1 ...	10	58	... + 7·5	... −1·3	... + 6·2
1890 April 4 ...	11	30	... − 3·4	... +0·5	... − 2·9
,, 9 ...	10	30	... −14·2	... +0·2	... −14·0
,, 10 ...	11	30	... − 0·3	... +0·1	... − 0·2
,, 11 ...	10	50	... + 7·6	... 0·0	... + 7·6
,, 13 ...	10	50	... −14·7	... −0·1	... −14·8
,, 15 ...	10	0	... +11·3	... −0·3	... +11·0

The observations have been reduced to the epoch 1890, April 2, 10h. Potsdam mean time, and the period of revolution of the system determined as 4 days 0·3 hours. The greatest motion in line of sight due to the orbital velocity is about 12 miles a second, and the system as a whole is moving towards the earth with a velocity of about 3 miles a second.

From this it is found that the distance between the components of the system is 660,000 miles, and their total mass = 1·2 that of the sun.

It will be remembered that Algol is a spectroscopic double of the same character as the above described.

THE METEORIC THEORY OF COMETS.—In the *Sidereal Messenger* for May, Mr. W. H. S. Monck discusses the evidence that has been brought forward in support of this theory, and in connection with the meteoritic origin of the universe. Only four comets are definitely known to be connected with meteor-showers; and conversely, only four meteor-showers have been connected with comets; these comets are all periodic, the longest period being 415 years. From this fact it is argued that there is not sufficient evidence to allow the assertion that all comets are connected with meteor-swarms and that the ejection theory advocated by the late Mr. Proctor is supported. It is asserted that, since an ejection from a rapidly cooling body may be partly solid, partly liquid, and partly gaseous, the gaseous matter might form the comet and the solid (or solidified) matter form the attendant meteors; but for this origin to be true the assumption must be made that two planets exist beyond Neptune. Mr. Monck argues that because Arcturus was seen through 90,000 miles of Donati's comet, whereas Saturn's rings (except perhaps the inner crape ring) are not transparent, the rings must be more than 1000 times as dense as the comet at the point where it crossed between us and Arcturus, hence meteoritic collisions should be more frequent and the effect of the increased temperature should be made clearly manifest in the spectrum. The meteoritic hypothesis is not, however, objected to as a working hypothesis, but is said to be on an equality with the older nebular hypothesis; and the writer does not think the spectroscope will ever afford a crucial test between the two, for the reason that it cannot distinguish between a large solid, surrounded by a gaseous envelope, and a number of small bodies with interspaces filled with gas.

MASS OF SHOOTING-STARS.—Mr. C. C. Hutchins, in the *American Journal of Science* for May, gives the result of an investigation undertaken with the object of finding data for determining the mass of shooting-stars. Having determined the radiant energy of the standard candle, it was found that on the supposition that the rays of a meteor have the same ratio of visible to total energy as those of the candle, the mass of a meteor at a distance of 50 miles, having a magnitude equal to Vega and a velocity of 25 miles per second, would be 0·2936 gram if it continued two seconds. If the meteor in burning produce, for a given expenditure of energy more light than the candle, then a less mass would serve to produce the light given by it. A lump of the Emmett Co. (Iowa) iron meteorite was placed upon the lower carbon of an arc lamp and vaporized by the passage of the current, and it was found that for a given expenditure of energy the arc of meteoritic vapour gave ten times the light of the candle, hence the mass of a meteor giving the light of a first magnitude star moving with parabolic velocity, and lasting for two seconds, is 0·029 gram.

PHOTOGRAPHS OF THE MOON.—Admiral Mouchez, at the meeting of the Paris Academy of Sciences of May 12, presented a note on some new photographs of the moon obtained by the Brothers Henry at Paris Observatory. The instrument used was the equatorial 0·32 metres aperture, destined for the map of the heavens. The photographs are said to be far superior to those obtained in England and the United States with larger apertures, the superiority of the results being ascribed not only to the perfection of MM. Henry's objectives, but also to the method of direct enlargement adopted.

THE ROYAL SOCIETY CONVERSAZIONE.

THE *conversazione* held by the Royal Society on May 14 was in every way most successful. The attendance was large, and everyone was pleased and interested by the programme. We note some of the objects exhibited :—

The Director-General of the Geological Survey exhibited :—(1) A series of specimens illustrating deep borings in the south of England. In this case was arranged a series of cores and specimens from all the deep bores which during the last thirty years have been made in the south of England in search of water. They included the borings at Richmond, Crossness, Kentish Town, Meux's Brewery, Streatham, Turnford, Ware, Chatham, Gayton and Orton in Northamptonshire, Harwich, and Swindon. The positions of these bores were shown on the large index

map suspended in the same room.—(2) Series of specimens illustrating the dynamical metamorphism of rocks. This case contained an important collection of specimens from Switzerland, Norway, and Scotland, illustrating some of the more remarkable effects of the mechanical deformation and recrystallization of rocks. The first series was one of specimens of Triassic and Jurassic dolomites and limestones from Canton Glarus, showing the extraordinary manner in which these rocks have been squeezed and puckered. Attention was particularly directed to the evidence afforded by the fossils (*Belemnites*) of the extent to which the strata have been stretched in some parts. The second series, from the south of Bergen, showed the presence of recognizable Silurian corals and trilobites in rocks which have been so much metamorphosed as to have acquired the characters of finely crystalline phyllite or micaceous schist. The third series, from the north-west of Scotland, illustrated how a massive quartzite, full of annelide-tubes, has been crushed and recrystallized until it has assumed the structure of a quartz-schist, and all trace of the fossils has been obliterated. The effects of mechanical movements even among the comparatively young and soft rocks of the south of England were illustrated by two specimens placed in this case from the under-surface of a "thrust-plane" in the vertical chalk of the Dorsetshire coast. They showed how the chalk has been indurated, smoothed, and polished by the movement of the overlying mass. A view and section of this thrust-plane were placed beside the specimens.

Specimens of minerals brought from Ceylon by C. Barrington Brown, exhibited by Prof. J. W. Judd, F.R.S. Large perfectly crystallized and clear beryl, 2650 grammes in weight. The specimen, though water-worn, exhibits the crystalline form. The colour is intermediate between that of emeralds and aquamines. The specific gravity is 2·703. Fine crystal of yellow corundum (oriental topaz). Well developed crystals of corundum (sapphires, &c.). Crystal of chrysoberyl from the same district.

Maps to illustrate magnetic surveys of special districts in the United Kingdom, exhibited by Profs. Rücker and Thorpe, FF.R.S. The arrows represent the horizontal disturbing forces in magnitude and direction. The figures give the vertical disturbing force in terms of 0·00001 C.G.S. units, taken as positive when it acts downwards. In some maps, regions of great (downward) vertical force are indicated by deeper tints. Map 1. Indications of an attracting centre at sea, to the south of the Hebrides. Map 2. Horizontal disturbing forces at stations near the boundaries of a district in Yorkshire and Lincolnshire, within which there is a locus of attraction. Map 3. Regions of high vertical force within the above district. The highest observed values are at Market Weighton and Harrogate. Map 4. Ridge line or locus of attraction drawn (continuous line) by connecting stations of maximum vertical force, and (dotted line) by connecting points midway between the stations at which the direction of the horizontal force disturbance changes. Map 5. Ridge line, 150 miles long, probably correct to within five miles for the greater part of its length.

Mr. C. V. Boys, F.R.S., exhibited :—(1) Oscillating spark experiment. This is a modification of the method employed by Dr. Lodge to show the oscillatory nature of a spark formed under proper conditions. Six lenses are mounted on a disk, and are made to rotate. Each forms upon a screen an image of the spark, which is drawn out by the movement of the lens into a broken band of light. The lenses are not exactly the same distance from the axis, so that the band formed by one is not overlapped by the band formed by the next. Thus the whole duration of the spark from the first to the last oscillation may be observed or photographed. —(2) Photographs showing the formation of drops. Water drops, half an inch or more in diameter, were allowed to slowly form and break away in a liquid of slightly lower specific gravity—namely, a mixture of paraffin and bisulphide of carbon. Photographs of these were taken as follows : they were illuminated by an electric arc and large condensing lenses, a camera was placed in front, and the view was rendered intermittent by a card disk with one hole near the edge made to rotate at from fourteen to twenty turns a second. The exposure was about one eight-hundredth of a second. Forty inches of photographic plate were arranged in a long slide which could be drawn past by hand. Three of these multiple photographs are exhibited. The thaumatrope was made by sticking the separate parts of the last series round a card disk, and afterwards painting the surface black and white, following the outlines of the photographs exactly. The thaumatrope clearly shows the gradual formation of the drop and the spherule, the oscillation of the pendant drop immediately afterwards, the rebound of the spherule from the pendant drop, the oscillation of the large drop as it falls, and its rebound from the water below into which it fell. Other photographs are shadows of water jets cast upon a photographic plate by the action of a small distant spark, a method invented by Mr. Chichester Bell. The remainder are photographic shadows cast by a water jet upon a rapidly moving plate by the intermittent light of an oscillating spark. These clearly show the movement of the separate water drops.

Sugar-cane (*Saccharum officinarum*) seed and seedlings, exhibited by Mr. D. Morris. There appears to be no authentic record of any really wild station for the sugar-cane, and the fruit has not hitherto been figured or described. At Barbados, several times during the last twenty years, and more recently by Prof. Harrison and Mr. Bovell, self-sown seedlings of the sugar-cane have been observed. The subject was taken up systematically in 1888, and about sixty of the seedlings raised to mature canes. Many of these exhibited well-marked characteristics differing from the varieties growing near them. Careful inquiry has shown that canes known as the "purple transparent" and "white transparent," and possibly also the "Bourbon" cane, produced seeds in very moderate quantities. Spikelets received at Kew have been examined and the seed found *in situ*. It is anticipated that, by cross-fertilization and a careful selection of seedlings, it will now be possible to raise new and improved varieties of sugar-cane, and renew the constitutional vigour of plants that have become deteriorated through continuous cultivation by cuttings or slips. Great importance is attached to the subject in sugar-producing countries, as it opens up an entirely new field of investigation in regard to sugar-cane cultivation.

Prof. H. Marshall Ward, F.R.S., exhibited a selection of transparent photographs, showing (1) the habits, &c., of various trees from different parts of the world ; (2) the comparative structure and anatomy of several European timbers ; and (3) some of the more prominent features of diseases of wood, &c., and fungi causing them.

The electrification of a steam jet, exhibited by Mr. Shelford Bidwell, F.R.S. The shadow of a small jet of steam cast upon a white wall is, under ordinary conditions, of feeble intensity and of a neutral tint. But if the steam is electrified, the density of the shadow is at once greatly increased, and it assumes a peculiar orange-brown hue. The electrical discharge appears to promote coalescence of the exceedingly minute particles of water contained in the jet, thus forming drops large enough to obstruct the more refrangible rays of light. It is suggested that this experiment may help to explain the intense darkness, often tempered by a lurid yellow glow, which is characteristic of thunder-clouds. See *Phil. Mag.*, Feb. 1890, p. 158.

Mr. Killingworth Hedges exhibited :—(1) Gramme dynamo worked as a motor, fitted with bearings of a new carbon composition, which does not require oil for lubrication.—(2) Vortex speed indicator, driven by the above, fitted with oilless bearings.

Lord Rayleigh, Sec.R.S., exhibited :—(1) An instrument for testing colour vision.—(2) Polarization of light by chlorate of potash crystals.

Photographs of eggs of the Great Auk, exhibited by Mr. Edward Bidwell. There are 67 recorded eggs of this extinct bird, of which 45 are in Great Britain. The collection of photographs exhibited consists of two views each of 53 of these eggs, photographed to scale.

Specimens of Simony's Lizard (*Lacerta simonyi*), from the lonely rock of Zalmo, near the Island of Ferro, Canaries, exhibited by the Zoological Society of London. A rare lizard, only known from this spot, and said to feed on crabs. These lizards were obtained by Canon Tristram, F.R.S., during his recent visit to the Canaries, and presented to the Zoological Society by Lord Lilford.

Electric-radiation meter, for obtaining quantitative measurements of the intensity of the radiations emitted by an electric oscillator, exhibited by Mr. Walter G. Gregory. Its action is based on measuring the increase of length of a stretched wire, or strip of metal, when heated by the currents induced in it by the rapidly varying field of force. In the instrument exhibited, the elongation of a fine platinum wire is shown by attaching to one end of it a fine helical spring made by winding a thin metallic ribbon round a cylinder. As the wire extends the spring rotates, and the motion is further magnified by a small mirror which reflects the image of a wire on a scale. The oscillator is

of the usual type, and is worked by an induction coil and four accumulators, the latter kindly lent by the Electric Construction Corporation.

Breath figures, showing that polished surfaces placed near to bodies in low relief often take an impression of the detail, which is made visible by breathing upon the surface (the period of exposure varying in different circumstances), exhibited by Mr. W. B. Croft. (1) A coin is lightly pressed on a freshly split surface of mica for 30 seconds; the mica takes a breath figure of the detail of the coin. (2) Paper printed upon one side has lain for 10 hours between two plates of glass; the print appears in white letters on both. Part of this phenomenon, although not with print, was noticed by Moser in 1840. (3) Sometimes the print appears in black letters; the same impression may change from white to black. (4) Coins are put on the two sides of a piece of glass and electrified for two minutes; each side has a perfect impression of that side of the coin which faced it. An electrotype plate may be reproduced in a similar way. These effects were partly indicated by Karstens in 1840. (5) An electric spark is sent across glass. Five superposed bands appear, black and white, of decreasing breadths, as well as three permanent scars. Riess, 1840. (6) The microscope shows water particles over the whole surface, larger or smaller as the effect is black or white.

Prof. Silvanus P. Thompson exhibited:—(1) Optical rotator. This apparatus is for rotating the plane of polarization of light, and is intended to be used in conjunction with polarizing reflectors (black-glass mirrors, &c.), which do not admit of being bodily rotated around the axis of the beam of light. The principle of the new rotator consists in the employment of two quarter-wave plates of mica, one of which is fixed at 45° across the plane-polarized beam of light, which it thus converts into circularly-polarized light. The second quarter-wave plate, which can be rotated by a simple gear, reconverts the circularly-polarized beam into plane-polarized light, vibrating in any desired azimuth. (Constructed by Messrs. Newton and Co.)—(2) Natural diffraction-grating of quartz. This specimen of iridescent quartz exhibits diffraction-spectra corresponding to those of a grating ruled to 12,000 lines to the inch. A micro-photograph taken by Mr. C. L. Curteis, with a Reichert's apochromatic (3 mm.) lens, shows the nature of the minute structures of the specimen. For the sake of comparison, a diffraction-grating of 6000 lines to the inch, photographed on glass, is exhibited beside the piece of quartz.—(3) New straight-vision prisms, consisting each of a single prism of Jena glass, of very wide angle, immersed in cinnamic ether. The materials having identical mean refractive index, rays of mean refrangibility pass straight through. (Constructed by Messrs. R. and J. Beck.)—(4) Colour experiments. Two liquids, incapable of mixing, are placed over one another in a flat bottle. They are chosen so that each absorbs all the rays that the other one can transmit. Though each is transparent, they are jointly absolutely opaque. They are also opaque when shaken up together.

Experimental illustration of the recent investigations of M. Osmond on molecular changes which take place during the cooling of iron and steel, exhibited by Prof. W. C. Roberts-Austen, F.R.S. In the case of mild steel, containing 0·5 per cent. of carbon, as it cools down from a temperature of 1100° C., two points may be observed at which heat is evolved. The first of these occurs at 750° C., and marks the change of β (or hard) iron to α (or soft) iron. The second evolution of heat is observed at 660°, and is due to a change in the relation of the carbon and iron. M. Osmond, in continuing an investigation made by Roberts-Austen, has shown that the presence in iron of elements with small atomic volumes retards the change of β to α iron, and, conversely, elements having large atomic volumes hasten the change.

Specimen of phosphorous oxide, and apparatus for preparing same, exhibited by Prof. Thorpe, F.R.S., and Mr. Tutton. This substance has been shown by the exhibitors to be represented by the formula P_4O_6. It crystallizes in monoclinic prisms melting at 25°·5, and boils in an atmosphere of nitrogen or carbon dioxide at 173°. Cold water dissolves it with extreme slowness, forming phosphorous acid. With hot water, strong caustic alkalies, chlorine, bromine, and alcohol it reacts with great energy, generally with inflammation. Oxygen slowly converts it, at ordinary temperatures, into phosphoric oxide, and under diminished pressure the combination is attended with a faint luminous glow similar to that observed in case of phosphorus. No ozone, however, is formed. At slightly higher temperatures the oxidation is brought about instantly with production of flame. Phosphorous oxide possesses the smell usually attributed to phosphorus, and which is identical with that noticed in match manufactories. It is highly probable, as Schönbein surmised, that the element phosphorus is without smell, and that the smell ordinarily perceived is due to a mixture of ozone and phosphorous oxide. Phosphorous oxide is highly poisonous, and it is not improbable that phosphorus necrosis is caused by this substance.

Photographs of the spectrum of the nebula in Orion, exhibited by Prof. J. Norman Lockyer, F.R.S. These photographs were taken in February with the 30-inch reflector at Westgate-on-Sea, the exposures varying from 2 to 3 hours. The one taken with a 3 hours' exposure (February 10) shows about 50 lines between λ 500 and λ 373, but many of them are only visible with difficulty, especially in artificial light. The Henry Draper Memorial photograph of the spectrum of P Cygni was shown for comparison, and it was seen that all the bright lines were amongst the brightest in the nebula. This argues in favour of the view that stars with bright-line spectra are of a nebulous character.

Photograph of the two clusters (33 and 34 H VI.) in the sword-handle of Perseus, showing remarkable coronal and festoon-like groupings amongst the stars on several parts of the photograph, exhibited by Mr. Isaac Roberts. These clusters are quite free from nebulosity, and in this respect they differ from other clusters which Mr. Roberts has photographed; for those clusters are involved in faint but distinct nebulosity.

The larvæ of Amphioxus, exhibited by Prof. E. Ray Lankester, F.R.S.

A selection from the butterflies collected in the great equatorial forest of Africa by Mr. William Bonny, one of Mr. Stanley's staff, exhibited by Mr. Henley Grose-Smith. Little was known of the Lepidoptera of this part of Africa; few of the species collected by Mr. Bonny have been previously recorded from that region, and nine are new to science. The collection includes, amongst others, the great *Papilio antimachus*, also *Papilio zalmoxis*, and many West African species.

Collection of iridescent crystals of chlorate of potash to illustrate the production of colour and its intensification by reflection from multiple thin plates, exhibited by Dr. Alex. Hodgkinson.

Dr. Alexander Muirhead exhibited:—(1) Some patterns of Dr. Lodge's lightning protector for cables and for telegraphic work generally. In these instruments a series of air-gaps, separated by self-induction coils, are offered to the lightning, or other high-tension currents, which have got into the line. The greater part of the flash jumps the first air-gap, most of the residue jump the next, and so on, until after four or five dilutions nothing is left which can break down the thinnest insulation, or appreciably affect even a delicate galvanometer connected to the protected terminals.—(2) Muirhead's portable form of the Clark standard cell, in cases, with thermometer.—(3) Standard condenser, $\frac{1}{2}$ microfarad (with Dr. Muirhead's certificate).—(4) Set of Thomson and Varley slides, small.—(5) Saunders's capacity key, suitable for Dr. Muirhead's capacity test.—(6) Saunders's reversing key.

Specimens of aluminium and alloys manufactured by the Aluminium Company, Limited, exhibited by Sir Henry E. Roscoe, F.R.S. Pigs of aluminium, 99 per cent. pure. Castings in aluminium, rough and finished. Specimens of aluminium, soldered. Aluminium wire, sheet and drawn rod. Aluminium medals, plain and gilt. Cast aluminium bronze and brass, showing (*a*) tensile strength and elastic limit; (*b*) twisting stress; (*c*) thrusting stress, long specimens; (*d*) thrusting stress, short specimens. Stampings in aluminium bronze, rough. Ten per cent. aluminium bronze, twisted cold. Five per cent. aluminium bronze, worked hot and cold. Aluminium brass, worked hot and cold. Aluminium bronze and brass sheet.

Specimens illustrating ancient copper and bronze from Egypt and Assyria, exhibited by Dr. Gladstone, F.R.S. The collection consists of borings from tools found by Mr. Flinders Petrie, at Kahun, in Egypt, and which belong to the XII. Dynasty—about B.C. 2500; also from other tools found at Gorub, which belong to the XVIII. Dynasty—about B.C. 1450. There are also fragments of Egyptian bronze figures from Bubastis, and of Assyrian bronze from the gates of the Palace of Shalmanezer II., at Balawat—about B.C. 840; as well as two pieces of slag from the old copper mines of the Sinaitic Peninsula, which were worked by the Egyptians in very early times, and discontinued after the XVIII. Dynasty. The principal point illustrated is the fact that the earliest metal implements were of copper, containing a very little arsenic and tin, probably as accidental im-

purities, and that afterwards tin was added to the copper in increasing proportions with the object of producing a hard alloy.

Mr. Percy Newberry, exhibited by permission of Mr. W. M. Flinders Petrie:—(1) Three pages of an ancient Egyptian book on medicine written on papyrus, by a scribe named Usertesen Sen, in the twenty-sixth or twenty-fifth century before Christ. This papyrus, together with a number of others of the same date referring to miscellaneous subjects (letters, legal documents, accounts, a fragmentary treatise on mathematics, &c.), was recently discovered by Mr. W. M. Flinders Petrie, during excavations in a ruined town of the XII. Dynasty, at Kahun, in Central Egypt. It contains directions for the use of midwives, written in black and red ink, in hieratic characters (a cursive or written form of hieroglyphics). The black ink is used in the body of the work for the symptoms, diagnoses, and prescriptions, and the red ink is used at the heads of the sections. The following translation of the last two and a half lines of the first page will serve to show the kind of directions given in this ancient work:—"*Treatment of a woman*[1] who is pained in her legs and in all her limbs, as one who is beaten. *Say with regard to her*,[1] it is the growth of the *at* (vulva). *Do thou with regard to her*[1] thus: let her eat grease until she is cured."—(2) Facsimile of an unpublished papyrus preserved in the British Museum containing medical prescriptions written in the Egyptian hieratic writing of the XIX. Dynasty (B.C. 1400–1200). This papyrus is chiefly interesting from the fact that it contains prescriptions copied from an earlier work, now lost, which is said (by the ancient copyist) to have dated from the IV. Dynasty (*circa* B.C. 4000). Facsimiles of these two papyri, together with translations, notes, &c., will shortly be published, under the editorship of Mr. F. Ll. Griffith and Mr. Newberry.

Egyptian spear-head of bronze, bearing the name and titles of Kames, a king at the end of the XVII. Dynasty, *circa* 1750 B.C., exhibited by Dr. John Evans, Treas. R.S. The blade is cast, and the socket is made of hammered bronze, and these two pieces that form the weapon seem to have been "burnt" together.

MM. Richard Frères, Paris, exhibited:—(1) Continuously recording hair hygrometer. This is the latest form of the Saussure hair hygrometer, so much used on the Continent, owing to its working satisfactorily when most other hygrometers fail, viz. near 32° F. In some of Saussure's instruments more than one hair was used, but in none did the apparatus give a continuous record. In the present hygrometer, the expansion and contraction of a bundle of hairs raise and lower a pen, which leaves on a paper-covered cylinder a continuous record of the humidity of any position, garden, or sick-room in which it may be placed. —(2) Curves produced by the anemometers on the summit of the Eiffel Tower, and on that of the Central Meteorological Office at Paris. These show (1) that the average velocity of the wind on the top of the tower (994 feet) is about 3½ times that at 66 feet, and (2) that the hour of greatest average velocity on the summit was 11 p.m., whereas at 66 feet (as at most observatories), it was 1 p.m.; so that the times of maximum and minimum are almost precisely reversed.—(3) Isochronous regulator for electric contacts. An instrument for making and breaking electrical contact at equal intervals of time.

Chætopodæ, Medusæ, Ascidians, Nudibranchs, and other Invertebratæ, prepared as lantern slides, showing not only the general form, but also much of their anatomy, exhibited by Mr. H. C. Sorby, F.R.S. The success of the method depends on the fact that when soft-bodied animals are dried on glass the extreme edge dries first, and adheres firmly, so that on further drying the animal does not contract irregularly, but becomes thin and flat, and shows like a drawing projected on the plane of the glass. In many cases the natural colour is well seen, but in other cases artificial staining is used, which brings out the anatomical structure to great advantage. In some cases the specimens are best seen by reflected light, and it is then well to use a photographic slide, taken under such conditions. Some details may also be brought out to greater advantage by means of a properly developed photograph.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Among the distinguished persons on whom honorary degrees will be conferred at the *Comitia Maxima*, on June 10, are the following:—Mr. Henry M. Stanley, Sir Andrew Clark, F.R.S., President of the Royal College of Physicians, Jonathan Hutchinson, F.R.S., President of the Royal College of Surgeons, George Richmond, R.A. (retired), Prof. J. J. Sylvester, F.R.S., Dr. John Evans, Treasurer R.S., and Alexander J. Ellis, F.R.S.

A discussion by the Senate took place on May 17, on the proposal, recently referred to in NATURE, that the experimental work in chemistry carried on by candidates previous to the Natural Sciences Tripos Examination (Part II.) should be allowed to count in determining the places in the Class List. The opinions expressed by members of the Senate were, in general, unfavourable to the proposal, as tending to diminish the confidence felt in the independence of the Examiners. It was stated that it would be impossible to make commensurable in practice the testimonials to the work of candidates given by different teachers; and further, that it would tend to make the superintendence of that work more formal, and so diminish its freshness and originality.

The Council of the Senate report that in January 1887, the late Mrs. Clerk Maxwell bequeathed the residue of her estate to the University for the purpose of founding a Scholarship in the Cavendish Laboratory at Cambridge, to be called the "Clerk Maxwell Scholarship." The estate of the testatrix has now been realized, and the residuary account furnished by the executors shows a balance of £5963 14*s.* 10*d.* with accruing interest on the sum of £5000 deposited with the National Bank of Scotland. After consulting the Lucasian and Cavendish Professors and Mrs. Clerk Maxwell's executors, the Council have framed regulations for the Scholarship, of which the following are the most important:—

A Scholarship to be called the Clerk Maxwell Scholarship shall be instituted in the University in connection with the Cavendish Laboratory, for the advancement by original research of experimental physics, and especially of electricity, magnetism, and heat.

The person elected to the Scholarship shall be called the Clerk Maxwell Student in Experimental Physics.

Any member of the University who has been a student for one term or more in the Cavendish Laboratory shall be eligible for the Scholarship.

The Electors to the Scholarship shall be the Cavendish Professor of Experimental Physics and the Lucasian Professor of Mathematics, and in case of any difference of opinion between them the final decision shall rest with the Master of Trinity College or with someone specially appointed by him for this purpose.

The Electors, in electing the student, shall be guided by the promise shown by the candidate of capacity for original research in experimental physics, and shall take such steps as they may think desirable to enable them to form a judgment of such promise.

The student so elected shall devote himself, under the direction of the Cavendish Professor, to original research in experimental physics within the University; he may, however, carry on his researches elsewhere if he has first obtained the written permission of the Cavendish Professor to do so.

The Scholarship shall be tenable for three years, and a student who has once held the Scholarship shall not be capable of re-election.

SCIENTIFIC SERIALS.

THE most important paper of original research in the numbers of the *Journal of Botany* for March, April, and May, is the conclusion of Mr. G. Massee's "Monograph of the Genus *Podaxis*," in which he gives his views of the systematic position of this genus of Fungi consequent on some recent discoveries as to its structure, together with descriptions of the seven known species, one of them new.—Messrs. H. and J. Groves describe and figure an interesting addition to the British flora in the minute *Nitella Nordstedtiana*.—Dr. W. O. Focke gives a description of no less than fifty-two species or forms of British *Rubi*.—Mr. R. A. Rolfe contributes a monograph of a small and interesting genus of Orchids, *Scaphosepalum*.—Mr. E. M. Holmes enumerates the marine Algæ of Devon.—Messrs. Britten and Boulger's "Biographical Index of British and Irish Botanists," has now advanced as far as the letter Q.

[1] In red ink.

WITH the exception of an enumeration of the flora of the little island of Giannutri, off the coast of Tuscany, the number of the *Nuovo Giornale Botanico Italiano* for April is chiefly occupied with a report of the meetings of the Italian Botanical Society, held sometimes at Florence, sometimes at Rome. The papers here reported are mostly of interest to Italian botanists: those of more general importance being chiefly by Prof. Arcangeli, who continues his researches on the interesting points of structure in the anatomy of *Euryale*, and other members of the water-lily family.

Memoirs of the St. Petersburg Society of Naturalists, Zoology and Physiology, vol. xix. No. 2.—The article on the fauna of the White Sea, by V. M. Shimkevitch, contains two separate monographs. One of them deals with the *Balanoglossus*, and is a detailed anatomical research into its structure, thus making a most valuable addition to the work of Kovalevsky, Agassiz, Metchnikoff, Spengel, Balfour, and Bateson. The author's conclusions are, that the *Balanoglossus* occupies an intermediate position between the worms and the *Chordata*. It has originated from a trochozoon which acquired some features in common with worms, as well as some features distinctive of the *Chordata*. The other monograph deals with the *Enteropsis dubius*, a new parasitic species closely akin to Aurivillius's *Enteropsis sphinx* (*Krustaceer hos arktiska Tunicater*). The morphology and embryology of this new Copepod are dealt with, and they are followed by general remarks about the history of development of parasitic *Copepods*. Both papers are well illustrated with plates.—A paper by N. N. Polejaeff deals rather too shortly with the following topics: on the filaments which are found in the *Hircinidæ* sponges; on spermatogenesis of the *Porifera*; on the anatomy of *Chalinidæ*; on the *Luffaria*; and on the new genus of *Porifera*, the *Korotnewia desiderata* (with plates).—The appendix to the same volume contains a detailed experimental inquiry, by A. Gendre, into the causes of death in animals when the excretory functions of the skin are artificially stopped.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 8.—"On the Heating Effects of Electric Currents. No. IV." By William Henry Preece, F.R.S.

The following table gives the fusing constants and fusing temperatures for all the metals in general use when bare and exposed in still air:—

	Fusing constant. (a)	Fusing temperature. C.
Copper	2530	... 1054
Silver[1]	1900	... 954
Aluminium	1873	.. 650
German Silver	1292	... 1200
Platinum	1277	... 1775
Platinoid	1173	... 1300
Iron	774·4	... 1600
Tin	405·5	.. 226
Lead	340·6	... 335
Alloy (lead 2 parts, tin 1 part)	325·5	... 180

The table means that if we take, for example, a uniform copper wire of 1 cm. diameter, a current of 2530 amperes will raise it to 1054° C., and therefore fuse it; and if we take any conductor of copper of similar form, but of different diameter (d), the fusing current (C) is

$$C = 2530d^{\frac{3}{2}}.$$

The fusing current of any other material is obtained from the equation

$$C = ad^{\frac{3}{2}}.$$

It seemed natural that these constants, marking such a distinct and well-defined fiducial point, should also enable us to obtain the currents that would raise the wire to any other temperature.

It is shown that if we determine C for any temperature, then, since $\theta = \kappa C^2$, θ being the rise of temperature, the current C′ producing any other temperature θ' is obtained by means of the equation

$$C' = C\sqrt{\frac{\theta'}{\theta}}.$$

[1] G. Roux, *L'Électricien*, December 14, 1889.

Now, for copper of 1 cm. diameter C = 2530 for 1054°. Thus, if we want to find the current that will raise such a conductor to 13°, we have

$$C' = 2530\sqrt{\frac{13}{1054}} = 281 \text{ amperes},$$

if the surface be equivalent to the normal surface at white heat.

The coefficient which converts this normal surface emissivity to that of the surface of ordinary wires at low temperatures by taking the normal surface as unity, is as follows:—

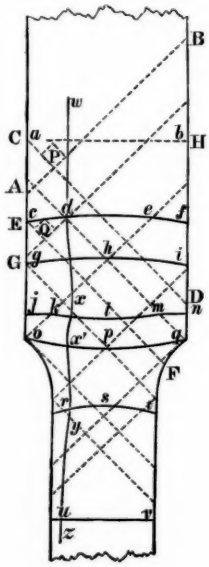
	Surface coefficient.
Bright and polished copper	0·5
Copper, dirty, oxidized, or blacked with shellac varnish	0·6
Copper, well coated with lamp-black	1·0

Thus, the current (C) producing 1054° (θ) in a bare bright copper cylinder of 1 cm. diameter is 0·5 × 2530 amperes, and that which would produce a temperature of 10° C. is

$$0{\cdot}5 \times 2530\sqrt{\frac{10}{1054}} = 123{\cdot}2 \text{ amperes}.$$

Thus, if we know the current producing any fixed temperature in any cylindrical conductor, we can readily calculate the current required for any other temperature.

Physical Society, May 2.—Prof. W. E. Ayrton, President, in the chair.—Mr. C. A. Carus-Wilson read a paper on the distribution of flow in a strained elastic solid. The author pointed out that when a bar is subjected to tensile stress the elements of the bar are distorted by the resulting shearing stresses which attain maxima in planes at 45° to the axis. If the bar be supposed to be divided into elements such as P or Q (see Fig. 1), then if the shearing strains are equal in the two directions



parallel to the sides of the elements, the bottom points of the strained elements will be directly below their top corners, whereas if the strains be different in the two directions there will be a displacement to one side or the other depending on which side the greater strain occurs. Since each inclined section is subject to the same total shearing force, the shearing strain along any section such as EF may be taken as inversely proportional to the length of the line EF, the bar being supposed of uniform thickness. From these considerations it may be seen that an element P will be subject to equal strains, for AB = CD, hence the lower point of P will remain vertically below its upper point. In this region, therefore, a horizontal straight line drawn

on the unstrained bar will remain horizontal and straight on the strained bar. An element at Q, however, will be subjected to unequal strains, for EF is < GH, hence the lower points of the elements will be displaced towards the axis. This displacement will increase as the distance beyond *d* and *e* from the axis increases, and an originally horizontal line will become curved at the ends *cd* and *ef*, whilst *de* will remain straight. In a similar way it was shown that horizontal lines should assume the shapes indicated at *ghi*, *jklmn*, *opq*, *rst*, and *uv*, in their respective positions, whilst vertical lines should become pinched inwards above and below the shoulder as shown by the curve *wxx'yz*. To test whether the reasoning, by which the above conclusions were arrived at, was satisfactory, a copper bar was carefully prepared, ruled, and subjected to permanent strain. The curvatures of the various lines clearly show the characteristics predicted by theory. Prof. Perry inquired whether it was correct to assume the stress uniform over the plane sections inclined at 45° to the axis. He also said that the general character of the flow somewhat resembled that of a viscous fluid passing from a wide to a narrower channel. Prof. Herschel thought Mr. Carus-Wilson justified in assuming the stress uniform over the diagonal sections; the latter said he only made the assumption as a provisional hypothesis, but the results of his experiment agreed so closely with his theoretical deductions that he thought the hypothesis correct.—Mr. C. V. Boys made two communications, (1) on photographs of rapidly moving objects, and (2) on the oscillating electric spark. A collection of apparatus by which he had been able to photograph drops of water in their various stages of formation was exhibited. It consisted of a lantern and lenses by which a trough in which the drops were formed could be strongly illuminated, combined with a camera and revolving disk with one perforation. By this means exposures of about 1/600 of a second could be made about 20 times a second. The slide of the camera was about 3 feet long, and could be moved across the field by hand so as to take the consecutive impressions on different parts of the plate. The resulting photographs show with remarkable clearness the formation, breaking away, the oscillations of the drops, and their rebounding in the liquid into which they fall. By cutting the photographs into strips, each strip representing a single exposure, and mounting them on a disk, Mr. Boys had arranged a kind of thaumatrope which represented the phenomena in a very realistic manner. He also exhibited photographs of small water fountains broken up into drops by musical sounds, which he had taken by the electric spark without the aid of lenses. The shadows of the drops were sharply defined even when magnified considerably, and the various stages of transition from the liquid column to the detached particles were well shown. Finding it possible to obtain such good results from a simple spark, it occurred to him that he might get a succession of photographs from the intermittent light of an oscillating spark, and in this he was fairly successful. An apparatus devised to show the oscillatory character of a discharge was next exhibited in operation. It consisted of a disk carrying six lenses arranged in two sets of three. The members of each set were at different distances from the axis so that the images of the spark on the screen do not coincide. The disk can be revolved at a high speed, and the successive sparks are seen as bright patches on the screen. By this apparatus a single discharge can be examined, whereas with Dr. Lodge's apparatus it is desirable to have a fairly rapid succession of sparks. Photographs of an oscillatory discharge taken with the apparatus were exhibited, and these show that the duration of the illumination is a considerable fraction of a complete period. Lord Rayleigh said he was greatly interested by Mr. Boys's apparatus. He (Lord Rayleigh) had photographed water fountains both when broken up, and when made to coalesce under electrical influence, but it had never occurred to him that it would be possible to get enough light or sufficient sharpness from a single spark. Mr. Boys's success he believed to be owing to the fact of his using no lenses, which would absorb the ultra-violet rays. He also thought the method might be developed so as to give shaded pictures instead of mere representations in black and white. Mr. Gregory asked Mr. Boys if he had tried to get greater potentials for his oscillatory discharges by using Dr. Lodge's "impulsive rush" arrangement. Mr. Trotter inquired whether the single sparks used to photograph the water fountains were as large as those required to show oscillations. Mr. Boys said he had not tried Dr. Lodge's "impulsive rush" arrangement because of the enormous capacity of the condensers required. The sparks used to photograph the broken up fountain were very small, being only about ¼ inch long, and from a few jars. Prof. Perry asked Lord Rayleigh whether it would be possible to compare the shapes of the water drops shown in the photographs with the shapes of the liquid surfaces of revolution given by Sir William Thomson at the Royal Institution some years ago, or whether the changes of shape were too rapid to permit of the surface tension being all important. Mr. Boys thought the motions of the drops would be too rapid, and that inertia would play an important part. Lord Rayleigh pointed out that by forming a drop slow enough the effect of inertia might be made negligible until such time as the unstable state was reached; after that, however, inertia must have considerable influence on the shape.

Geological Society, April 30.—Dr. A. Geikie, F.R.S., President, in the chair.—The following communications were read:—On certain physical peculiarities exhibited by the so-called "raised beaches" of Hope's Nose and the Thatcher Rock, Devon, by D. Pidgeon.—The Devonian rocks of South Devon, by W. A. E. Ussher, of H.M. Geological Survey. This paper is the result of work done in continuation of the labours of the late Mr. Champernowne, and refers particularly to the area north of the Dart and east of Dartmoor. Owing to the complicated stratigraphy of the region, we have to fall back upon such information as can be procured of the general types of Upper, Middle, and Lower Devonian faunas; for though the lithological constituents of these three divisions are broadly distinguishable, there are no definite lithological boundaries between them. The Lower Devonian is mainly distinguished by the occurrence of sandstone and grit, but the upper beds are shales passing into the Middle Devonian slates. The Middle Devonian consists of limestones, and shaly limestones upon slates, the latter representing the Calceolen-Schiefer, and containing *Spinifer speciosus*. *Stringocephalus* is found here and there in the middle Devonian Limestones. The upper part of the middle Devonian Limestones (with Lummaton fauna) passes into the *Cuboides* beds of the Upper Devonian. The Upper Devonian contains thin-bedded limestones, often concretionary, with chocolate-red and pale greenish slates and mudstones. These beds correspond to the Goniatiten-Schichten, Kramenzelstein and Knollenkalk of Germany, and to the Cypridinen-Schiefer. In the Upper and Middle Devonian rocks we find a local prevalence of schalstein and tuffs, breaking up the limestones. The slate and sandstone type of Upper Devonian in North Devon appears to give place southward to a purely slate type, possibly accompanied by overlap of the Culm measures. The author groups the South Devon rocks under the following heads:—

Upper.	1. Cypridinen-Schiefer. 2. Goniatite-limestones and slates. 3. Massive Limestones.
Middle.	4. Ashprington Volcanic Series. 4. Middle Devonian Limestones. 5. Eifelian slates and shaly limestone.
Lower.	6. Slates and sandstones, generally red. 7. Slates with hard grits.

After discussing the relationship of the Lincombe and Warberry beds and the New Cut Homalonotus beds, the author notes the discovery of *Pleurodictyum* by Mr. Whidborne in the railway cutting at Saltern Cove. He proves the Lower Devonian age of the Cockington beds and their correlation with the Torquay Lower Devonian by the discovery of fossils. He considers it probable, though not certain, that the main mass of Meadfoot beds is below the Lincombe, Warberry, and Cockington sandstones. The distribution of the Middle Devonian Limestones is described. *Stringocephalus* is found in limestones containing *Rhynchonella cuboides*. The upper parts of the limestone-masses (East Ogwell, Kingskerswell, Barton, Ilsham, &c.) may be Upper Devonian. The massive limestones may terminate abruptly or pass laterally into shales, and the whole mass of the limestones seems to be replaced by slates between the Yealmpton and Totnes areas. The commencement of the phase of volcanic activity which caused the accumulation of the Ashprington series is shown to coincide with the latest stage of Eifelian deposition, and the Ashprington series may represent continuous or intermittent vulcanicity up to a late stage in the Upper Devonian. North of Stoke Gabriel a mass of limestone seems to have been formed contemporaneously with the volcanic material on the immediate borders of which it occurs. Elsewhere the limestones are interrupted by local influxes of volcanic

material. The occurrence of other local developments of Middle and Upper Devonian volcanic rocks is described. The relationship of the Middle and Upper Devonian deposits varies. In some cases Upper Devonian shales may have been deposited against Middle Devonian limestones; in others there is a continuous development of limestone, the Middle Devonian limestones being succeeded by *Cuboides* beds, *Goniatite* limestones, and Knollenkalk. The local variations of these are described, and fossil lists are given. The Knollenkalk is shown to pass under *Entomis* bearing beds ("Cypridinen-Schiefer"), which are described, though a detailed account of their relationship to the Culm-measures is reserved for a future occasion. After the reading of this paper, some remarks were offered by the President, Prof. T. Rupert Jones, Prof. Hughes, and the author.

PARIS.

Academy of Sciences, May 12.—M. Hermite in the chair.—New lunar photographs by the Brothers Henry, of Paris Observatory, by M. Mouchez (see Our Astronomical Column).—On volume iii. of the "Annales de l'Observatoire de Nice," by M. Faye.—Experiments on the deformations undergone by the solid envelope of a fluid spheroid submitted to the effects of contraction; possible applications to dislocations of the terrestrial globe, by M. Daubrée. In order to obtain the necessary oblateness, spherical balloons of vulcanized caoutchouc, having disks of the same material affixed at the extremities of a diameter, were used. The disks gradually increased in diameter, so that the thickness gradually decreased from the poles in each hemisphere, and unequal pressure was exercised on the liquid contained in the balloon. The oblateness has been determined of various liquid spheroids, and the conditions of production of ridges and fissures similar to those exhibited in the earth's crust.—On the retardation of foliation in Provence during the spring of 1890, by M. G. de Saporta. The low temperature and the abnormal humidity having exercised a very sensible influence during the spring of this year on vegetation in the middle of France, the author has investigated the state of foliation at the beginning of May in a locality situated at Saint-Zacharie (Var), in the high valley of Huveaune, at an altitude of about 200 metres.—On an hydraulic instrument with a new model of turbine for the continued utilization of the power of rivers, by M. Paul Decœur.—The difference between the surface of the earth taken as fluid and that of an ellipsoid of revolution having the same axis, by M. O. Callandreau. It is shown that in the case of a supposed fluid earth the maximum depression for latitude 45° is 9·1 metres, which agrees with the value given by M. Helmert in his "Géodésie supérieure."—On surfaces possessing a train of geodetic conjugates, by M. C. Guichard.—On some particular cases of visibility of interference fringes, by MM. J. Macé de Lépinay and Ch. Fabry.—On undulatory transverse magnetization, by M. C. Decharme. It appears from some experiments given that a continuous electric current traversing the length of a tempered cylinder of steel may become undulatory on account of the resistance which the molecular actions of the magnetic medium oppose to it.—A note by M. A. Witz describes a method of exploration of magnetic fields by tubes of rarefied gases.—On the double chlorides of iridium and phosphorus, by M. G. Geisenheimer. By heating in a sealed tube at 300° C. 1 gram of iridium hydrate with 10 grams of PCl_3 and 15 grams of PCl_5, and reheating the yellow crystalline mass obtained with $POCl_3$ to 250°, a body possessing the empirical formula $Ir_2P_3Cl_{15}$ is formed in fine clear yellow crystals. By appropriate treatment several other double chlorides are obtained therefrom. An acid corresponding to the body $Ir_2P_3Cl_{15}$ is the product obtained on evaporating an aqueous solution of the latter as far as possible. The analyses of the salts of this acid indicate that the formula for the double chloride above should be written $2Ir_2Cl_3, 3PCl_3, 3PCl_5$.—A note on a characteristic reaction of hydrogen dioxide, by M. G. Denigès. A 10 per cent. solution of ammonium molybdate in water added to its own volume of concentrated sulphuric acid gives with a few drops of hydrogen dioxide an intense yellow coloration.—On the existence of microlithic peridote in the andesites and labradorites of the ridge of the Puys, by M. A. Michel Lévy.—On the contact phenomena of elæolithic syenite at Pouzac (Hautes-Pyrénées), and on the transformation into *dipyre* of the felspar of the ophitic rock in the same bed, by M. A. Lacroix.—On the metamorphic rocks of Pouzac, by M. Ch. L. Frossard. These rocks, occupying a space of 1250 m. by 300 m., extending from the railway near Monloo, appear to have been principally modified by the syenite. The ophite of Palassou has hardly acted upon the surrounding rocks. The rocks of which the modifications are attributed by the author to the action of the syenite are in the state of a fragmentary breccia and are without trace of fossils or indications of stratification. They may be classed as—siliceous, hard compact argillaceous, amphibole, talcose, chloritic, limestone, and dolomite rocks.—On the organisms of nitrification, by M. S. Winogradsky. The author has succeeded in isolating the nitrifying microbe, and has found that neither its rate of multiplication nor its vigour of action is diminished by cultivation in a mineral solution quite devoid of organic carbon. The colourless microbe of nitrification is thus capable of a complete synthesis of its substance from carbonic acid and ammonia. This fact is in direct contradiction with the fundamental doctrine of physiology that a complete synthesis of organic matter only occurs in chlorophyll-bearing plants, under the action of luminous rays.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Elementary Statics, new edition: Rev. J. B. Lock (Macmillan).—Dynamics for Beginners, 3rd edition: Rev. J. B. Lock (Macmillan).—Capital and Interest: E. V. Böhm-Bawerk: translated by W. Smart (Macmillan).—First Lessons in Political Economy: F. A. Walker (Macmillan).—Sketches of British Sporting Fishes: J. Watson (Chapman and Hall).—Yachting Guide and Tide Tables, 1890: A. Thomson (Pall Mall).—A Guide to the Literature of Sugar: H. Ling Roth (K. Paul).—Nautical Surveying: Vice-Admiral Shortland (Macmillan).—La Géographie Zoologique: Dr. E. L. Troussart (Paris, J. B. Baillière).—American Economic Entomology, Part 1, The More Important Writings of Bishop—Walsh (Washington).—Picturesque Wales: G. Turner (Adams)—Practical Chemistry for Medical Students: S. Rideal (Lewis).—Catalogue of the Birds in the Provincial Museum, North-West Provinces, and Oudh, Lucknow (Allahabad).—Masken von Neu Guinea und dem Bismarck Archipel: Dr. A. B. Meyer (Dresden, Stengel and Markert).—Anoa Depressicornis (H. Smith): Dr. K. M. Heller (Berlin, Friedländer).—Abhandlungen und Berichte des Königlichen Zoologischen und Anthropologisch-Ethnographischen Museums zu Dresden, 1888-89: Dr. A. B. Meyer (Berlin, Friedländer).—Harpur Euclid, Books 5, 6, 11: E. M. Langley and W. S. Phillips (Rivingtons).—On Aphasia, or Loss of Speech, 2nd edition: Dr. F. Bateman (Churchill).

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